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Table of Contents.

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ORIGINAL ARTICLES—	Page.
On the Heat-Absorbing or Heat-Lifting Capacity of Wind in Relation to the Human Body, with a Table for Calculating it, by C. E. Corlette, M.D.	453
Note on a Diagram for the Calculation of the Heat-Absorbing Capacity of a Cubic Metre of Air, Based on the Tables of Dr. C. E. Corlette, by W. H. H. Gibson, M.E., B.Sc.	464
Notes on the Use of the Tourniquet, by R. S. Lahz	465
Mycobacterium Tuberculosis in Milk, by O. Kudelka	466
The Operative Treatment of Hyperphoria, by E. Temple Smith	468
REVIEWS—	
Seasonal Influences on Growth, Function and Inheritance	468
A Text-Book of Surgery	468
LEADING ARTICLES—	
The Surgery of Malignant Disease of the Rectum	469
CURRENT COMMENT—	
Staphylococcus Aureus Bacteriemia	470
The Blood Picture in Rheumatic Fever	471
Pneumatic Rupture of the Colon	472
Canada's War Effort	473
The Effect of the Host on the Parasite	473
ABSTRACTS FROM MEDICAL LITERATURE—	
Surgery	474

BRITISH MEDICAL ASSOCIATION NEWS—	Page.
Annual Meeting	478
CORRESPONDENCE—	
The Treatment of Burns	480
Blood Serum in the Treatment of Burns and Wounds	480
A Fracture Service: Addendum	480
NATIONAL EMERGENCY MEASURES—	
The Necessity for Economy in X-Ray Film and Radiographic Materials	480
NAVAL, MILITARY AND AIR FORCE—	
Appointments	481
OBITUARY—	
Walter Ferguson Straede	481
Friedrich Carl Bechtel	481
AUSTRALIAN MEDICAL BOARD PROCEEDINGS—	
Tasmania	482
New South Wales	482
NOMINATIONS AND ELECTIONS	483
MEDICAL APPOINTMENTS	482
BOOKS RECEIVED	482
DIARY FOR THE MONTH	483
MEDICAL APPOINTMENTS: IMPORTANT NOTICE	483
EDITORIAL NOTICES	482

ON THE HEAT-ABSORBING OR HEAT-LIFTING CAPACITY OF WIND IN RELATION TO THE HUMAN BODY, WITH A TABLE FOR CALCULATING IT.

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INTRODUCTION.

IN the daily Press the records of officially observed atmospheric conditions are regularly published. The particulars given include the temperature readings, the degree of humidity, the barometric pressure, and the direction and velocity of the wind, at stated hours.

It will be shown here with these data it is possible to discover much more, namely, the heat-absorbing, heat-lifting, or refrigerating capacity, so far as the human body is concerned, of any given quantity of the air, whether still or moving at any stated velocity. For if we work out the problem for one cubic metre, and then read the velocity of the wind in metres per second, we can state the heat-absorbing capacity as so many calories per cubic metre per second. This is not the heat that the given quantity of air actually does remove from the human body, but the calculation shows what it could carry if filled to capacity at that temperature with heat derived from any source.

The information thus derived is not dry and unproductive, but very much otherwise. It supplies us with a numerical means of expressing climatic characteristics that can and must exert important physiological effects. By this means it allows us now to make more accurate and more definite comparisons of wind with wind, day with day, season with season, local climate with local climate,

where previously there was no rational method of coordinating data for that purpose or of giving a numerical expression to the results.

Another use of the method is its applicability to problems of ventilation. Ventilation is largely concerned with warming and cooling, moisture and dryness, and the quantitative information here made available, being suitable for mathematical treatment, gives new facilities, enabling the ventilating engineer to handle effectively data that are otherwise refractory and impenetrable.

Climatology and ventilation, though special departments of study, are linked up with hygiene, and therefore with medicine. Certain problems of hygienic and medical importance have forced themselves into attention and are considered here. It seemed to be possible to solve them and to construct a table facilitating the necessary calculations. However, such a table would be a formidable undertaking. I was deterred by the magnitude of the task, but at length, as there seemed to be no one else, I felt constrained to turn to it.

The working out of the method needed much careful reasoning, but I am sure it will be accepted as sound. I have deliberately made the paper rather long by giving the whole structure of the argument in detail. In the circumstances, it is necessary to do so.

The full calculation of a result in any given case without the use of the table here given is so intricate, and involved in so many difficulties and pitfalls, that it is beyond general reach. The key table removes this difficulty.

PHYSIOLOGY OF HEAT DISPERSAL AND TEMPERATURE REGULATION.

The body is a centre of combustion through which energy is liberated for various purposes. A large amount of this energy takes the form of heat, and it is by the regulation of heat production and heat dispersal that the

temperature of the body is kept at uniform level. If heat production exceeds heat loss, the body temperature must rise. If heat loss is in excess of production, the temperature must fall.

Without making it necessarily a rigid line, one can say that the heat regulating apparatus pivots at a point marked approximately by a skin temperature of 33° C. (F. A. Collier and W. G. Maddock⁽²⁾). Below that point the regulation of temperature is carried on by adjustment of the rate of combustion, the rate increasing as the environment temperature falls, and according to need. On the other hand, as the skin temperature rises above that of the environment air, there is a loss of heat by conduction into the air. When the skin is flushed with blood, this loss of heat by conduction is accelerated, and there is at the same time an important increase in the heat lost by radiation. When the temperature of 33° C. is reached, the secretion of sweat occurs. Then by sweat vaporization excess heat is dissipated so that further rise of temperature is prevented or made difficult. The surface temperature may at times rise above 33° C., but it occurs as a temporary condition only. Sweating, however, is not the only form of water loss through the skin. There is an invisible perspiration occurring at temperatures below 33° C., and this is especially abundant in the feet and hands (F. C. Benedict and H. H. Wardlaw⁽³⁾). Nevertheless, sweat secretion is definitely the physiological response to a rise of skin temperature above 33° C., which therefore becomes a critical point. The vaporization of sweat is the normal means of discharging excess heat above that point, though it is assisted by the other physical factors mentioned.

When physical regulation is the governing factor, heat production is probably reduced to the minimum. The minimum for an individual man seems to depend in some part on the degree to which he is acclimatized. If he is acclimatized to a tropical temperature, his metabolism becomes adjusted to the physiological requirements of his environment. Heat production becomes habitually lower, and correspondingly less evaporation and less sweat production will then be needed. When this adjustment is established, the individual is released from much physiological strain and bodily discomfort. Acclimatization and comfort seem to be closely related, but the table is not directly concerned with the measurement of comfort.

The channels of heat loss are: (i) warming and moistening to saturation of the inspired air, (ii) voiding of warm excreta, (iii) warming, by conduction, of air below 33° C. in contact with the skin or its coverings, (iv) vaporization of insensible skin perspiration, (v) vaporization of sweat secretion, (vi) radiation.

The body temperature varies in different situations. The deeply situated parts of the trunk are at an average of a little over 37° C. There is a fall of temperature as the surface is approached (A. C. Burton⁽⁴⁾). The skin surface is warmest on the trunk beneath the clothing, being at or near 33° C., but it may be found as low as about 31° C. or lower, or as high as 34° C. or higher, under room temperatures varying from 20° to 25° C. (A. C. Burton⁽⁴⁾, F. A. Collier and W. G. Maddock⁽²⁾). The skin surface on the extremities is in ordinary circumstances several degrees lower than 33° C., especially at their most distal and most exposed parts. When covered, and protected against heat loss, the skin of the extremities rises in temperature to become equal to that of the trunk, bringing the average skin temperature of the whole body to about 33° C. (F. A. Collier and W. G. Maddock⁽²⁾).

There has been some difference of opinion as to the mode of excitation of sweating. The preponderance of opinion is that in ordinary circumstances the outbreak of sweating is a direct response to elevation of skin temperature beyond 33° C. If there is some other less direct mechanism, it cannot make any material difference to the fact that 33° C. (91° F.) is a critical temperature. Nor will it matter much if the skin temperature level for the outbreak of sweating is not exactly the same in every individual, in every part of the body, in all circumstances.

We have to set a convenient temperature level for the zero point of the table, and since 33° C. is a point of

physiological importance in regard to temperature regulation, that temperature has been adopted.

I have calculated, and shown in the key table (Table I), the total quantity of heat, in calories, that must be added to, or taken from, a cubic metre of air, measured at various temperatures, firstly to bring it to 33° C. by heat conduction, and secondly, to saturate it with moisture at that temperature, at a standard atmospheric pressure of 1,000 millibars.

A cubic metre of air will have a different weight with every difference of temperature, every difference of humidity, and every difference of atmospheric pressure. Viewed from another aspect, the same original weight of air will have a different volume with each difference of temperature, humidity and pressure. At 33° C. it might measure much more or much less than a cubic metre. All this must be taken into account in the calculations. Table I makes it easy to work out results between -60° C. and +55° C.

It is necessary to employ certain physical constants in the calculations. These are: (i) the coefficient for expansion with changes of temperature, according to the law of Charles, (ii) the specific heat of dry air, (iii) the specific heat of water vapour, and (iv) the latent heat of vaporization of water at the stated temperature. The specific heat of dry air I took as 0.2375. I took 0.4 as approximately the figure for specific heat of water vapour. In actual fact it turns out that it is of negligible importance. On the other hand, the latent heat of vaporization is important. Calculated by Regnault's formula, the latent heat of vaporization at 33° C. is 583.56 small calories. Using some figures given by Callendar (H. B. Callendar⁽⁵⁾), I calculated it as 577.74 calories for the same temperature. The mean between these two results is 580.6 calories, and for working purposes 580 calories was adopted as an approximate mean suitable for use. This is 0.58 of a large calorie.

Atmospheric pressure was standardized at 1,000 millibars. A table constructed to this standard is easier to work with than the older system of standardization at 760 millimetres of mercury, because any pressure shown can be stated at sight as a decimal of the standard. Moreover, as far as meteorological work goes, the millibar system has superseded the other system.

For densities of air and water vapour in differing circumstances of temperature and humidity, I used, as far as possible, the data given in the "Smithsonian Meteorological Tables", fourth revised edition, 1918. Where these tables failed, as they did for the weights of a cubic metre of saturated vapour below -29° C. and above 40° C., I calculated out an extension of the table (Table 74, S.M.T.¹) for myself, using the same method as was used for the already existing part.

The figures in the Smithsonian tables are calculated to a barometric pressure of 760 millimetres of mercury. They had, therefore, to be corrected to a pressure of 1,000 millibars.

The key table is calculated to degrees Centigrade. It is not carried to fractions of a degree. Near the bottom of the scale the intervals are more than one degree. It will be easy for anyone desiring to use the table frequently to construct for himself a subsidiary table of fractions, such as tenths, by use of squared paper or otherwise. Within some calculations, small fractions may be useful, but the original meteorological observations themselves are not of such accuracy that very small fractions need to be used in stating final results.

And now, by the courtesy of Mr. W. H. H. Gibson, we have something more. This is a nomogram, which is able to shorten the work. With a moderate-sized nomogram it is easy to get out results at sight accurate to at least two-tenths of a calorie. All the user has to do then is a simple subtraction to separate conduction calories and vaporization calories, and after that the multiplication by atmospheric pressure and wind velocity.

¹ S.M.T. = "Smithsonian Meteorological Tables".

THE LINE OF REASONING.

It will be observed that the figures in the table refer only to air that is either completely dry or completely saturated. This needs a little explanation. In actual work one will not have to deal with completely saturated air. It will be at various percentages of full saturation, and of course a cubic metre will have a different weight for every different percentage of saturation. At first sight this looks difficult to deal with by calculation, but in reality it is quite easy. A humidity of 50% is equivalent to a mixture of 50 parts of completely saturated air with 50 parts of completely dry air, by weight, and similarly for other humidities. Thus a humidity of 40% is equivalent to a mixture of 40 parts saturated with 60 parts dry.

The actual calculation of the heat-absorbing capacity of a cubic metre of air at 33° C. and 1,000 millibars pressure should be made as follows.

Refer to the S.M.T., and from data therein calculate the weight Δ of a cubic metre of a sample of saturated air at the stated temperature and at the pressure adopted in the tables as standard. Then, from Table 74, S.M.T., or otherwise, find n , the weight of water vapour in a cubic metre at saturation point, at the same temperature and pressure. Obviously, the weight a of the vapour-free portion is found by the formula $a = \Delta - n$. Consequently, a carries n water vapour at the stated temperature. Or one could put it that a is associated with n at that temperature.

Next we find the weight b of one cubic metre of completely dry air at the same temperature and pressure. This can be derived from Table 98, S.M.T., by the simple process of shifting a decimal point, a process equal to multiplying by 10⁴.

Heat has to be added to a , to n , and to b , to warm each up to 33° C. If the initial temperature is above 33° C., heat has to be subtracted instead of added. The heat added or subtracted in warming or cooling a , n and b to 33° C. is calculated out to large calories, and the value is corrected from the original pressure of 760 millimetres of mercury to that of 1,000 millibars. This corrected value I call C_1 for a , C_2 for n , and C_3 for b , respectively. To do this, one finds the number of degrees t through which the temperature has to be raised or lowered. Then a , n and b have each to be multiplied by t , then by the specific heat, which is 0.2375, symbolized as θ for a and b , and 0.4, symbolized as s for n , and finally they have to be multiplied by the coefficient correcting to 1,000 millibars pressure. This correcting for pressure is easily done, for 760 millimetres of mercury correspond to 1,013.3 millibars, and the ratio 760:1,013.3 makes the coefficient 0.98687. For this I have used the symbol ϕ . The correction by ϕ makes the result the same as if the original observations had been made at a pressure of 1,000 millibars.

The calculation of the large calories required for warming or cooling a , n , and b , and symbolized by C_1 , C_2 and C_3 , respectively, may therefore be represented by the following statements:

$$\begin{aligned} C_1 &= at\theta\phi \\ C_2 &= nt\theta\phi \\ C_3 &= bt\theta\phi \end{aligned}$$

But if a starts at any temperature below 33° C., it will be able to carry more than n water vapour at the higher temperature, although it was at saturation point at the lower temperature. There will be $n + m$ water vapour at the higher temperature.

To find the value of m , it becomes necessary first to find the weight of water vapour that could be held by Δ the original weight of air, if it were raised to 33° C. This quantity Δ by definition, measured one cubic metre at the original stated temperature. With the aid of Tables 98, 99, and 100 of S.M.T. we calculate the weight W of one cubic metre of saturated air at 33° C. and at a pressure of 760 millimetres of mercury. This weight W we find to be 1.1317 kilograms, and we find from Table 74 S.M.T. the weight h of water vapour present in one cubic metre of saturated air at 33° C. This is 35.656 grammes.

Then, if d be the weight of the vapour-free portion of saturated air at 33° C.,

$$\begin{aligned} d &= W - h \\ &= 1.09604 \text{ kilograms.} \end{aligned}$$

Consequently, d carries, or is associated with, h . That is, 1.09604 kilograms of dry air carries, or is associated with, 35.656 grammes of water vapour at 33° C. when saturated.

The calculation then becomes one of simple proportion. If d can carry so much, how much can a carry at the same temperature? Let this be x . Then $x = \frac{ah}{d}$. That is,

the quantity of air that measured one cubic metre at the stated initial temperature can carry a weight x of water vapour at 33° C. At the initial temperature it carried n weight. Therefore, at 33° C. it can carry $x - n = m$ more water vapour.

If λ is the latent heat of vaporization of water at 33° C., then the heat of vaporization of m is $m\lambda$, and corrected to 1,000 millibars it is $m\lambda\phi$.

So if C_4 is the number of large calories required to vaporize m at 33° C. and at 1,000 millibars, the formula is:

$$C_4 = m\lambda\phi.$$

Finally, we calculate in large calories the heat required to vaporize at 33° C. and at 1,000 millibars the water that could be carried by b if it was fully saturated under those conditions. It is another case of simple proportion. If d can carry h at 33° C. and at 760 millimetres, how

much can b carry? If this is designated y , then $y = \frac{bh}{d}$.

But in practice it is not necessary to work out the value of y in figures. We go straight on to work out the heat required to vaporize at 33° C. and correct it to 1,000 millibars. If this result is C_5 , the inclusive formula is:

$$C_5 = \frac{d\lambda\lambda\phi}{d}$$

The Conditions at 33° C.

From their starting point at 33° C. the calculations pass on without any change of formula beyond 33° C. and up to the chosen upper limit at 55° C.

It will be of advantage to consider here how the body surface is affected when the atmospheric temperature is above 33° C. Careful reasoning is required, for not everything is immediately obvious.

Heat will pass by conduction from the warmer to the cooler. If there is contact for one instant of time, however short, between the skin and any portion of air, however small, that portion will lose energy to the skin. If the skin is at 33° C., the air concerned in the contact will be able to take up only so much water as is equal to saturation at 33° C., the temperature to which it has been reduced on making contact. It will only be a matter of time for the whole mass of a cubic metre to become converted to the same temperature level as obtains at the point of contact, the heat being conducted to the skin until it is in equilibrium. What we are concerned about in these calculations is potential capacity, not how long it takes or how the contact is established. If we admit the change for one molecule we must admit it for all, as a potentiality. This is fundamental, and of course it is the same fundamentally whether the air temperature is above or below 33° C.

As is shown in the table beyond, the calculations reveal that as the temperature of the air rises there is a progressive diminution in the heat-lifting capacity of absolutely dry air. This is surprising at first, but the explanation soon appears. The fact is due to the gradual decrease in weight of a cubic metre as it rises in temperature. If we adopt, for the occasion, measurements at 760 millimetres, a cubic metre of dry air at -60° C. weighs as much as 1,659.47 grammes. This weight can carry 53.971 grammes of water vapour at 33° C., whereof the latent heat of vaporization amounts to 30.901 large calories. But at 55° C. a cubic metre weighs no more than 1,075.9 grammes, which is 583.57 grammes less, and those 1,075.9

grammes can carry proportionately less water vapour at 33° C.—namely 35.002 grammes—with a latent heat of vaporization amounting to no more than 20.30 calories.¹ If these 1,075.9 grammes of dry air could retain at 33° C. the absorptive capacity that they possessed at 55° C., before cooling, they could carry an enormously greater amount of water vapour, no less than 123.35 grammes, involving 71.55 large calories as latent heat of vaporization, three and a half times as much as at 33° C. But they do not retain that capacity.

Take next the case of saturated air. What happens above 33° C. is a reversal of direction in the transfer of heat. Air saturated at a lower temperature than 33° C. can take up more water vapour when warmed. But if it has been saturated at a temperature higher than 33° C., it loses heat when it makes contact with the skin, and owing to the fall in temperature thus produced it becomes incapable of holding the initial amount of water vapour. The excess moisture would be precipitated as dew on the skin if the whole of the air were saturated, but since we are concerned (at least mathematically) with a mixture of dry air and saturated air, water is not precipitated if enough dry air is present to take it up.

For the purpose of study, let us suppose that the dry air and the saturated air were not mixed, but made contact alternately with the skin. Then dew would be precipitated on the skin, and the latent heat of vaporization released. This heat must be conducted into the body through the dew if the air is still to remain at 33° C., and it must remain at 33° C. unless the body accumulates so much heat that the skin temperature rises. The dew and the body surface become of one temperature through conduction. Now let the completely dry air make contact, the air being at the same temperature. This dry air will be able to take up moisture as vapour and will absorb from the body the latent heat of vaporization corresponding to the water taken up. Thus it will be drawing from the body, in which it has been stored, the heat released just before by the condensation. In this way it comes about that via the skin surface the latent heat passes from the saturated to the dry. We now imagine the alternations so rapid that they equal the molecular movements in frequency, and we reach the point at which the dry part and the moist can be taken as mixed. It follows that the transference of heat and moisture takes place as if directly from moist to dry air, and to the extent that this occurs, so is heat loss from the body prevented.

Application of the Method to an Example.

In order to show the method of construction in practice, let us now carry through a calculation of the heat-absorbing potentiality of one cubic metre at 20° C. and at 1,000 millibars pressure when raised to 33° C., first at saturation point, and second when vapour-free. With these data found, it is easy to find the value at any degree of humidity.

§ 1. The first thing to do is to find the weight of a cubic metre of saturated air and of the vapour-free portion of it. This calculation is made from data in the Smithsonian tables. The formula is:

$$\delta = \frac{0.00129305}{1 + 0.00367t} \left(\frac{B - 0.378e}{760} \right)$$

in which

δ is the weight of a cubic centimetre of air, in grammes.

B is the atmospheric pressure in millimetres of mercury.

e is the pressure of water vapour in millimetres of mercury.

t is the temperature in degrees Centigrade.

Let the weight of a cubic metre of air be Δ . Then, since 1 cubic metre = 10^6 cubic centimetres,

$$\Delta = \delta \times 10^6.$$

Working from Tables 98, 99, and 100 S.M.T., at 20° C. we have $t = 20$, $B = 760$, and $0.378e = 6.63$, and from the

same tables we derive logarithms corresponding to the value of the terms. Therefore:

$$\log. \delta = \log. \frac{0.00129305}{1 + 0.00367t} + \log. \frac{B - 0.378e}{760}$$

$\delta = 0.0011941$ gramme = weight of one cubic centimetre of air at saturation point at 20° C. and at 760 millimetres of mercury.

$$\Delta = 0.0011941 \times 10^6.$$

$= 1194.1$ grammes = 1.1941 kilograms = weight of one cubic metre of air at saturation point at 20° C. and 760 millimetres of mercury.

By Table 98, S.M.T., the weight of one cubic centimetre of dry air is 0.0012046 gramme at 20° C. and 760 millimetres of mercury pressure. Therefore the weight of one cubic metre = $0.0012046 \times 10^6 = 1,204.6$ grammes = 1.2046 kilograms.

Let us call this b .

At temperature 20° C. and at a pressure of 760 millimetres:

Let a equal the weight of dry portion of saturated air in one cubic metre.

Let n equal the weight of water vapour in one cubic metre at saturation point. (The value of n at this temperature and pressure is given in Table 74, S.M.T., as 17.3 grammes.)

Let b equal the weight of one cubic metre of dry air = 1,204.6 grammes = 1.2046 kilograms.

Δ = weight of one cubic metre of saturated air = 1,194.1 grammes = 1.1941 kilograms.

$$\text{Then } \Delta = a + n$$

$$a = \Delta - n$$

$$= 1,194.1 - 17.3 \text{ grammes}$$

$$= 1,176.8 \text{ grammes} = 1.1768 \text{ kilograms.}$$

§ 2. Next find the large calories C_1 required to warm a from 20° to 33° C. through 13 degrees of temperature ($t = 13$), corrected to a pressure of 1,000 millibars. The specific heat (θ) of dry air = 0.2375. The coefficient (ϕ) to standardize at 1,000 millibars = 0.95687.

The formula for the calculation is:

$$C_1 = at\theta\phi$$

$$\log. C_1 = \log. a + \log. t + \log. \theta + \log. \phi$$

$$C_1 = 3.5856 \text{ large calories.}$$

§ 3. Next find the large calories C_2 required to warm n , corrected to 1,000 millibars, from 20° to 33° C. The specific heat (s) of water vapour = 0.4. Other symbols are as in the preceding calculation.

The formula for the calculation is:

$$C_2 = nt s \phi$$

$$\log. C_2 = \log. n + \log. t + \log. s + \log. \phi$$

$$C_2 = 0.083778 \text{ large calories.}$$

§ 4. Next find the large calories C_3 required to warm b , corrected to 1,000 millibars, from 20° to 33° C. The symbols are as before.

The formula for the calculation is:

$$C_3 = bt\theta\phi$$

$$\log. C_3 = \log. b + \log. t + \log. \theta + \log. \phi$$

$$C_3 = 3.6703 \text{ large calories.}$$

§ 5. We now calculate the weight of additional water vapour that can be carried by the vapour-free portion of one cubic metre of saturated air, saturated at 20° C., when its temperature is raised to 33° C.

It has already been shown that the weight of a , the vapour-free portion of one cubic metre of saturated air, saturated at 20° C. and at 760 millimetres of mercury pressure, is 1,176.8 grammes, and we find from Table 74, S.M.T., that a carries 17.3 grammes of water vapour. We also find in Table 74 that at 33° C. there are 35.656 grammes in one cubic metre of saturated air at the same pressure.

Let us now find the weight d of the vapour-free portion of one cubic metre of saturated air at 33° C.

We shall first have to find the weight w of one cubic centimetre of air saturated at 33° C. and at 760 milli-

¹ In Table I one finds 20.34 calories opposite the temperature 55° C. This is because the table is calculated to 1,000 millibars.

metres of mercury pressure. This is found by calculating from data in the S.M.T. Then $w \times 10^6 = W$ = weight of one cubic metre of saturated air at the same temperature and pressure.

The formula in §1 for finding the weight of a cubic centimetre at 20° C. applies also to this calculation; but since in §1 we used δ for a cubic centimetre at 20° C., we here use w for a cubic centimetre at 33° C., and W for a cubic metre at the same temperature.

From the tables, at 33° C. $t = 33$, $B = 760$, and $0.378e = 14.28$.

Therefore, if the logarithms for the corresponding values are used,

$$\log. w = \log. \frac{0.00129305}{1 + 0.00367t} + \log. \frac{B - 0.378e}{760}$$

$w = 0.0011317$ gramme = weight of one cubic centimetre at saturation point at 33° C. and at 760 millimetres of mercury.

$$W = 0.0011317 \times 10^6$$

$= 1.131.7$ grammes = 1.1317 kilograms = weight of one cubic metre of saturated air at 33° C. and at 760 millimetres of mercury.

By Table 74, S.M.T., we have seen that there are 35.656 grammes of water vapour in one cubic metre of saturated air W at 33° C. Then, if d is the weight of the vapour-free portion,

$$\begin{aligned} d &= W - h \\ &= 1.131.7 - 35.656 \\ &= 1.096.04 \text{ grammes.} \end{aligned}$$

Let us now find x , the weight of water vapour that could be carried by a if warmed up to 33° C.

Let d equal the weight (1.096.04 grammes) of dry air in one cubic metre of saturated air at 33° C. and at 760 millimetres of mercury.

Let h equal the weight (35.656 grammes) of water vapour carried by d at 33° C.

Let a equal the weight (1.176.8 grammes) of dry air in one cubic metre of saturated air at 20° C.

Let x equal the weight of vapour which a could carry at 33° C.

Now, if 1.096.04 grammes of dry air can carry 35.656 grammes of water vapour, how much can 1.176.8 grammes carry at the same temperature? If the symbols are used, the problem is:

$$\begin{aligned} x &= \frac{ah}{d} \\ \log. x &= \log. a + \log. h - \log. d \\ x &= 38.295 \text{ grammes of water vapour.} \end{aligned}$$

We have now seen that at 20° C., a carries n water vapour, and that it can carry x water vapour at 33° C., and we have found the values of n and of x . If m is the weight of the added water vapour, then

$$\begin{aligned} m &= x - n \\ &= 38.295 - 17.3 \\ &= 20.995 \text{ grammes of water vapour.} \end{aligned}$$

§ 6. Let us now calculate the large calories C_1 absorbed by latent heat of vaporization of the additional water that can be carried by a when its temperature is raised from 20° to 33° C., and standardized as at 1,000 millibars.

Since the latent heat λ of vaporization of water at 33° C. is 0.58 of a large calorie per gramme, the latent heat of vaporization of m is $m\lambda$, and at 1,000 millibars it would become $m\lambda\phi$. Therefore:

$$\begin{aligned} C_1 &= m\lambda\phi \\ \log. C_1 &= \log. m + \log. \lambda + \log. \phi \\ C_1 &= 12.017 \text{ large calories at 1,000 millibars.} \end{aligned}$$

§ 7. Next find the large calories required to vaporize the water that could be carried by one cubic metre of absolutely dry air if raised from 20° C. at 760 millimetres of mercury to 33° C. and saturated at that temperature, the pressure being as at 1,000 millibars.

Let b equal the weight (1.2046 kilograms) of one cubic metre of dry air at 20° C. and 760 millimetres of mercury.

Let d equal the weight (1.096 kilograms) of the vapour-free portion of air in one cubic metre of air saturated at 33° C. and at 760 millimetres of mercury pressure.

Let h equal the weight (35.656 grammes) of the vapour carried by d .

Let λ equal the latent heat (0.58 large calorie per gramme) of vaporization of water at 33° C.

Let ϕ equal the coefficient (0.98687) to correct pressure from 760 millimetres of mercury to 1,000 millibars.

Let C_2 equal the required heat, in large calories.

If 1.096 kilograms carry 35.656 grammes of water, how much can 1.2046 kilograms carry? How much heat does this amount require to vaporize it? And how much would it be if the standard were 1,000 millibars instead of 760 millimetres of mercury? The calculation is:

$$C_2 = \frac{b\lambda\lambda\phi}{d}$$

$$\begin{aligned} \log. C_2 &= \log. b + \log. h + \log. \lambda + \log. \phi - \log. d \\ C_2 &= 22.431 \text{ large calories.} \end{aligned}$$

Of course, in making a series of calculations for building up a table, one does not make everything as long as in the work shown. For instance, in the last calculation four of the terms are constant, and in practice the four are simplified into one quantity for repetition.

THE KEY TABLE.

The section just finished will, I think, sufficiently explain the method followed in the construction of the key table (Table I). A perusal of it will also confirm the remark that it is intricate and beset with pitfalls. Incidentally it shows that a table involving a long series of these calculations means a good deal of work. The figures and their differences show smooth curves when plotted on squared paper, and it is believed that no serious errors exist.

In Table I the columns have been placed in the order which will be most convenient to users. It will be seen later why this is convenient.

Explanatory Note to the Key Table.

The standard pressure is 1,000 millibars.

Column 1 gives the stated temperatures in degrees Centigrade.

Column 2 gives the large calories added to warm, or removed to cool, one cubic metre of dry air from the stated temperature to 33° C.

Column 3 gives the number of large calories absorbed or given up in the addition or subtraction of water vapour to saturate at 33° C. one cubic metre of air previously saturated at the stated temperature.

Column 4 gives the number of large calories absorbed in saturating one cubic metre, measured at the stated temperature, when raised to 33° C.

Column 5 gives the number of large calories added to warm, or removed to cool, the vapour-free portion of one cubic metre of saturated air from the stated temperature to 33° C.

Column 6 gives the number of large calories added to warm, or removed to cool, to 33° C. the vapour present in one cubic metre of air saturated at the stated temperature.

For use in calculations based on the table I have given to the columns of calorie values the symbols a , b , c , d , e , respectively. These symbols have nothing to do with those used in the preceding calculations.

The negative sign applied to the figures above 33° C. in the calorie columns a , b , d , and e signifies that the direction of the flow of calories is reversed, so that the heat passes from the air to the body, tending to warm it. In all other cases the direction of flow is from the body to the air.

TABLE I.
The Key Table.

1 Temperature. (Degrees Centigrade.)	2 Values of a.	3 Values of b.	4 Values of c.	5 Values of d.	6 Values of e.
-60°	36-171	30-892	30-901	36-170	0-0004
-50°	30-907	29-467	29-489	30-901	0-001
-40°	25-930	28-143	28-221	25-927	0-003
-30°	21-455	26-851	27-057	21-443	0-008
-25°	19-354	26-184	26-511	19-341	0-013
-24°	18-942	26-008	26-403	18-911	0-014
-23°	18-536	25-889	26-298	18-522	0-014
-22°	18-132	25-744	26-192	18-117	0-018
-21°	17-732	25-597	26-090	17-714	0-017
-20°	17-334	25-446	25-986	17-316	0-019
-19°	17-340	25-292	25-883	16-921	0-020
-18°	16-549	25-135	25-781	16-491	0-022
-17°	16-161	24-973	25-680	16-130	0-023
-16°	15-787	24-778	25-579	15-735	0-025
-15°	15-395	24-694	25-481	15-369	0-027
-14°	15-018	24-457	25-382	14-986	0-028
-13°	14-638	24-257	25-283	14-599	0-030
-12°	14-266	24-069	25-187	14-234	0-032
-11°	13-895	23-895	25-088	13-848	0-034
-10°	13-528	23-695	24-995	13-493	0-037
-9°	13-162	23-486	24-900	13-125	0-039
-8°	12-802	23-270	24-807	12-761	0-041
-7°	12-441	23-055	24-712	12-406	0-044
-6°	12-086	22-807	24-621	12-040	0-046
-5°	11-731	22-562	24-527	11-684	0-049
-4°	11-380	22-306	24-446	11-330	0-052
-3°	11-031	22-111	24-345	10-980	0-054
-2°	10-685	21-777	24-256	10-638	0-057
-1°	10-342	21-466	24-166	10-284	0-060
0°	10-016	21-157	24-079	9-940	0-063
1°	9-683	20-904	23-991	9-619	0-066
2°	9-326	20-554	23-902	9-261	0-068
3°	8-993	20-229	23-816	8-924	0-070
4°	8-662	19-901	23-730	8-592	0-073
5°	8-333	19-545	23-645	8-260	0-075
6°	8-006	19-185	23-559	7-932	0-077
7°	7-683	18-810	23-476	7-608	0-079
8°	7-361	18-410	23-392	7-286	0-082
9°	7-041	17-992	23-306	6-960	0-084
10°	6-734	17-560	23-226	6-641	0-085
11°	6-409	17-112	23-149	6-326	0-087
12°	6-096	16-645	23-062	6-013	0-088
13°	5-785	16-143	22-982	5-699	0-089
14°	5-477	15-630	22-902	5-390	0-090
15°	5-171	15-089	22-822	5-083	0-091
16°	4-868	14-523	22-742	4-779	0-091
17°	4-564	13-940	22-663	4-477	0-091
18°	4-264	13-324	22-585	4-177	0-091
19°	3-966	12-681	22-509	3-880	0-090
20°	3-670	12-017	22-431	3-586	0-088
21°	3-378	11-308	22-355	3-293	0-087
22°	3-085	10-574	22-280	3-004	0-084
23°	2-796	9-809	22-204	2-717	0-081
24°	2-507	9-008	22-129	2-432	0-077
25°	2-226	8-171	22-055	2-151	0-073
26°	1-941	7-297	21-980	1-864	0-067
27°	1-657	6-412	21-907	1-598	0-061
28°	1-374	5-454	21-835	1-324	0-054
29°	1-096	4-435	21-762	1-052	0-046
30°	0-8190	3-396	21-690	0-7847	0-036
31°	0-5442	2-312	21-619	0-5201	0-025
32°	0-2712	1-148	21-548	0-2584	0-013
33°	0-0	0-0	21-477	0-0	0-0
34°	-0-2894	-1-232	21-407	-0-2553	-0-015
35°	-0-5371	-2-513	21-338	-0-5073	-0-031
36°	-0-8031	-3-854	21-267	-0-7550	-0-049
37°	-1-067	-5-249	21-200	-1-001	-0-069
38°	-1-330	-6-703	21-131	-1-243	-0-091
39°	-1-591	-8-217	21-062	-1-481	-0-115
40°	-1-850	-9-794	20-995	-1-715	-0-144
41°	-2-107	-11-409	20-928	-1-948	-0-170
42°	-2-363	-13-148	20-863	-2-172	-0-201
43°	-2-617	-14-928	20-796	-2-394	-0-234
44°	-2-870	-16-781	20-731	-2-612	-0-270
45°	-3-121	-18-684	20-665	-2-829	-0-310
46°	-3-371	-20-710	20-600	-3-035	-0-352
47°	-3-619	-22-774	20-535	-3-243	-0-396
48°	-3-865	-24-961	20-472	-3-437	-0-477
49°	-4-110	-27-155	20-407	-3-636	-0-499
50°	-4-353	-29-351	20-345	-3-828	-0-566
51°	-4-594	-31-990	20-282	-4-006	-0-617
52°	-4-835	-34-544	20-219	-4-185	-0-681
53°	-5-074	-37-241	20-157	-4-353	-0-752
54°	-5-312	-39-848	20-096	-4-524	-0-825
55°	-5-548	-42-652	20-034	-4-684	-0-905

APPLICATION OF THE TABLE.

We are now in a position to calculate with facility the heat-lifting or heat-absorbing capacity of any sample of wind, so far as its effect on the human body is concerned. But before proceeding to this it is desirable to consider certain points in connexion with the data as to wind velocity. It is customary to record this in terms of miles per hour in round numbers. If, therefore, a wind velocity is given as 50 miles per hour, it may mean

anything between 49.5 and 50.5, a latitude of statement equal to 1% above or below 50. A wind velocity given as 25 miles per hour means anything between 24.5 and 25.5, a statement allowing a margin of 2%. Correspondingly, a velocity of 10 miles per hour allows a margin of 5%. Again, the recording instruments are not extremely accurate. We must, therefore, regard statements of velocity as approximations only. They mean that the wind was about the velocity stated.

Bearing all this in mind, we note in the table that Column 6, showing the heat absorbed in warming or cooling the water vapour, gives a series of figures that are too small to consider seriously. They may be neglected. Column 5 deals with the dry portion of saturated air just as Column 6 deals with the vapour in the same air, and if the figures in Columns 5 and 6 are added together, we find that for practical purposes we may just as well use Column 2. This reduces the labour of calculating without impairing the value of the result; so we neglect Columns 5 and 6, and use the figures in Column 2 for the whole cubic metre, whatever the degree of humidity. Therefore, in calculating values, we find the calories required to warm, or to be given up in cooling, one cubic metre, which I call the "conduction" heat, and then, separately, the calories required in the humid and the dry fractions for vaporization, or, in certain cases, not required but discharged. This will be better understood if the method shown in the detailed example given beyond is studied.

The term "convection" has not been used, because convection currents act by evaporating sweat, as well as by taking conducted heat.

The Examination of a Sample of Wind.

We have to find, in terms of large calories per cubic metre per second, the following heat values:

x = Conduction heat; calculated as for a whole cubic metre. The reasons have been discussed above.

y = Heat absorbable in vaporizing, or dischargeable on condensing (devaporizing) water, as the case may be, so as to adjust to saturation at 33° C. the humid fraction of air—that is, the fraction calculated as in a saturated condition at the original stated temperature and pressure. The reasons have been discussed above.

z = Heat absorbable in vaporizing water to saturate at 33° C. the fraction calculated as absolutely dry at the original stated temperature and pressure. The reasons have been discussed above.

2. From Meteorological Observation:

h = Humidity, stated as a fraction calculated as fully saturated air.

g = Fraction calculated as completely dry air.

p = Atmospheric pressure in millibars, stated as a ratio of 1,000 millibars.

v = Velocity of wind in metres per second.

If the temperature readings are in degrees Fahrenheit, we convert them to Centigrade readings.

If the atmospheric pressure has been recorded in inches of mercury, we convert it to a reading in millibars. If a table is not available, it must be calculated on the datum that one inch = 33.86395 millibars. The conversion from millimetres of mercury into millibars has been dealt with already.

The figures for wind velocity are usually recorded in miles per hour. For our purpose we must have velocity stated in metres per second. The quickest way of converting miles per hour into metres per second is by looking it up in a table—for example, Table 36 of the Smithsonian series. If a table is not available, it must be calculated on the datum that one mile per hour is 0.4470409 metre per second.

The formulae for calculating the values of x , y and z are obviously as follows:

$$x = apv$$

$$y = bhpv$$

$$z = cgpv$$

Demonstration of the Method of Calculating Refrigerative Capacity of a Wind.

For an illustration of the method of calculating the refrigerative capacity of a wind, let us now examine a wind sample, choosing a common summer afternoon wind at Sydney—the north-easter.

TABLE II.

Place.	Date.	Time.	Direction.	Temperature.	Humidity.	Pressure.	Velocity.
Sydney.	March 2, 1930.	3 p.m.	N.E.	75.6° F. 24.22° C.	64%	30.179 inches of mercury. 1,022 millibars.	18 miles per hour. 8.05 metres per second.

When, for any given sample of wind, we have calculated separately the values of x , of y , and of z , the final results are obtained as follows:

x = Conduction heat per cubic metre per second.

$y + z$ = Vaporization heat per metre-second. But when b , and consequently y , has a negative sign in the table, it is $z - y$.

$x + y + z$ = Total heat-lifting capacity per cubic metre-second. If y has a negative sign, it is subtracted, and similarly for z .

Data to be Used in Calculation.

1. From Table I:

a = Heat taken up to warm, or lost to cool, one cubic metre from the original temperature and pressure to 33° C. at 1,000 millibars.

b = Heat absorbed or discharged in adjusting to saturation at 33° C. and at 1,000 millibars the humid fraction of the air, starting at the original temperature and pressure.

c = Heat required to saturate at 33° C. and at 1,000 millibars the absolutely dry fraction of the air.

Since the figures in Table I are calculated to intervals of 1° C., it is necessary to interpolate for fractions of a degree.

In Column 2, for values of a we find that $a = 2.507$ at 24° C. and 2.226 at 25° C. We regard 24.22° C. as 25° C. - 0.78° C. The calorie difference for the interval between 25° C. and 24° C. is 0.281. Therefore the amount to be added to 2.226 is $0.78 \times 0.281 = 0.219$ calories.

Therefore $a = 2.226 + 0.219 = 2.445$ calories at 24.22° C.

Similarly for values of b ; we find that $b = 9.008$ at 24° C. At 25° C. we find that $b = 8.171$. The calorie difference is $9.008 - 8.171 = 0.837$. The amount to be added to 8.171 is $0.78 \times 0.837 = 0.653$ calorie.

Therefore $b = 8.171 + 0.653 = 8.824$ calories at 24.22° C.

For values of c , we find that $c = 22.129$ at 24° C. and 22.055 at 25° C. The difference is $22.078 - 22.055 = 0.074$. The amount to be added to 22.055 is $0.78 \times 0.074 = 0.057$ calorie.

Therefore $c = 22.055 + 0.057 = 22.112$ calories at 24.22° C.

By interpolation, therefore, we have found that at 24.22° C.:

$$a = 2.445$$

$$b = 8.784$$

$$c = 22.112$$

Then by the formula

$$\begin{aligned}x &= apv \\ \log. x &= \log. a + \log. p + \log. v \\ x &= 20.115 \text{ large calories.} \\ y &= bhpv \\ \log. y &= \log. b + \log. h + \log. p + \log. v \\ y &= 46.461 \text{ large calories.} \\ z &= cgpv \\ \log. z &= \log. c + \log. g + \log. p + \log. v \\ z &= 65.490 \text{ large calories.}\end{aligned}$$

Results.

Conduction heat capacity per cubic metre-second = x
= 20.115 large calories, say 20.

Vaporization heat capacity per cubic metre-second = $y + z$
= 46.461 + 65.490 = 111.951 large calories, say 112.

Total heat-absorbing capacity of the wind per cubic metre-second at 33° C. = 20 + 112 = 132 large calories.

If the conduction heat in the example had been at a temperature above 33° C., it would have had a reversed action, warming the body instead of being warmed by it. In that case, x would have to be subtracted from $y + z$ instead of added to it, because a , and therefore x , has the negative sign.

The same applies to the vaporization heat represented by b , for then there will be liberated heat units corresponding to the condensation or devaporization necessary to adjust to saturation at 33° C.

As an example, we may take a wind to be mentioned later, the west-north-west wind of 3 p.m. on February 22, 1930. The temperature was 40.39° C., the humidity 25%, the pressure 1,000.4 millibars, the velocity 10.28 metres per second. The value of y was 26.8, but all of this represented calories reversed in direction so as to add to the body heat. The value of z was 161.73, but z calories are directed away from the body at all temperatures, whether above or below 33° C. Therefore, the vaporization calories were $z - y = 135$.

Shortened Method.

The north-east wind of March 2, 1930, considered above, can be dealt with more shortly if one's equipment is prepared for these calculations. First, one should be provided beforehand with a table showing, for column a , the calories worked out for tenths of a degree, by interpolation. Squared paper can be used for this. The next thing is to have at hand the nomogram constructed by Mr. W. H. Gibson, with its scale at a size convenient for its purpose—that is, some 35 centimetres (or 14 inches) in length. Then we find at once, by reading it off, that at temperature 24.22° C. (taken as 24.2° C., the nearest tenth) and standard pressure, the heat capacity of one cubic metre by conduction (value of a) is 2.45 calories. Next, by applying carefully a suitable straight-edge to the diagram, or nomogram, we find that at temperature 24.22° C. (or say 24.2° C.), humidity 64%, and standard pressure (1,000 millibars), the total heat capacity of one cubic metre is approximately 16 calories. Then by subtracting the 2.45 conduction calories from the total heat capacity of 16 calories, we find the heat capacity through vaporization to be 13.55 calories at the same temperature, humidity and pressure. The only thing to do now is to correct for the pressure p and wind velocity v observed—that is, to multiply each by 1.022 and 8.05.

$$\begin{aligned}2.45 \times 1.022 \times 8.05 &= 20.156 \text{ (say 20) large calories per} \\ &\quad \text{cubic metre-second} \\ &= \text{conduction heat capacity.} \\ 13.55 \times 1.022 \times 8.05 &= 111.4 \text{ (say 111) large calories per} \\ &\quad \text{cubic metre-second} \\ &= \text{vaporization heat capacity.}\end{aligned}$$

But whatever the method of working, the examples just given show that now the key table has been constructed, the rest is comparatively easy.

FURTHER REMARKS ON RELATION TO SKIN CONDITIONS.

Since the facts regarding the physiology of temperature regulation may not yet be firmly fixed in the minds of all, let me repeat that, except during fog, or when clothing is damp, the conduction heat capacity is the only one to consider when the skin temperature is below 33° C., the critical point. But the general air temperature may be much below 33° C. while the skin is much warmer, not merely beneath the clothing, but sometimes even the exposed parts, and it may be then actively sweating, a condition further discussed in connexion with the wind of June 9, 1929. If it be true that most people tend to keep the skin beneath their clothing at a temperature near to 33° C., the immediate environment of the skin approximates the warmth and moisture of a tropical atmosphere. Sweating will occur easily and freely on relatively small additions of heat from within the body, and so give scope for the vaporizing capacity of the air, whatever the temperature outside the clothing.

But for all that, the fact remains that the vaporization capacity of air is latent, not an active property, unless the skin temperature is high enough for sweating. When a wind is of such temperature that it has a large conduction capacity for cooling, it will prevail to keep the skin temperature too low for sweating unless there is enough muscular activity to cause an excess of heat production. Therefore, in stating the heat-lifting capacity of a wind, it will not be right to mention the total only, because that may suggest a fallacious conclusion. The proper way, in every case, will be to state separately the conduction capacity and the vaporization capacity. Of these, the conduction capacity is the more important one for people inhabiting countries with cool climates. The vaporization capacity is the more important to dwellers in hot climates, or in any country with hot summers.

The Influence of Fog or Mist.

A note should be made here as to the conditions prevailing in the presence of fog or mist—that is, in the presence of particles of moisture suspended in the atmosphere. It has just been remarked that in the case of fog or of damp clothes there was an exception to the rule that the conduction heat capacity was the only one that mattered when the skin temperature was below 33° C. If air containing suspended water in the liquid condition comes into contact with the human body, and the surface of the body is warmer than the air, heat will flow from the body to the air by conduction. But the liquid water will tend to become vaporized as the air in contact rises in temperature, and there is only one reservoir from which to draw latent heat of vaporization, namely, the human body. Therefore, other things being equal, a fog-laden atmosphere has proportionately greater refrigerating properties than an atmosphere that is merely saturated with moisture in the form of vapour, having no content of liquid water. The conditions resemble, in part, those existing when the skin is sweating, but they differ in that the temperature at the surface may, at the same time, be far below 33° C. If the air were moving fast, or if one were travelling fast through the air, a great heat loss might occur. Any liquid moisture deposited on the clothing must, if vaporized, draw its heat of vaporization from the body. If the clothing is wet through, there is also an increased power of conduction loss, the function of clothing as a defence against heat loss being destroyed. These two modes of increased heat loss suggest a reason for the frequent ill result of a wetting combined with exposure.

One may further remark in this connexion that the sensation of increased coldness experienced on entering a fog will not be due only to a drop in the temperature of the air. Some part is loss of heat by vaporization of liquid water suspended in the air, unless the skin is so cold, even under the clothing, that its temperature is the same as the air outside the clothing.

We could calculate the potential refrigerating capacity of a fog-laden atmosphere if we knew the weight of liquid water in suspension.

SURVEY OF RESULTS OF STUDY OF A SERIES OF
DIFFERENT WINDS.

Further on is given a tabulated series of sample wind readings given by the courtesy of Mr. D. J. Mares, of the Sydney Weather Bureau. The majority are from Sydney, but there are others of great interest, a wind from Edmonton, in Alberta, a wind from Marseilles, and a tropical hurricane. I have calculated the heat-lifting capacity of all these winds, and placed the results in the table. It should be found interesting, for it introduces a new way of studying, classifying, and comparing wind, or indeed any air current. Since we can now give a numerical expression to such an important characteristic as the heat-absorbing capacity, and can state separately the amount due to conduction and to vaporization, comparative studies of wind and of climate in this respect can be made precise and quantitative, and that is a thing we could not do before. It has been found difficult to get material for study, apart from local sources. One would like readings of a Malta sirocco, a Tripolitan sirocco, a khamsin, a mistral, a bora, a *pampero*, and so on. There is also scope for broader studies extending to mean readings for seasons and places.

The wind from Marseilles belongs to the summer season. If the figures are examined, it will be seen that it is distinct in its character from every other wind in the series. It has a greater conduction loss capacity than other warm weather type winds, and it combines with this a potential loss by vaporization that is greater than the hottest, and almost as great as the coldest, dry westerly wind of Sydney.

Next comes the tropical hurricane from Cairns, North Queensland. A hurricane is a terrifying visitation. One need not stop to paint a picture of the danger, distress and general discomfort of such an experience. But one of the most remarkable features of a hurricane is the intense cold of which everyone complains. If we look at the figures for conduction heat-absorbing capacity in this example, we find an explanation. Notwithstanding that the temperature was as high as 24.44° C. (76° F.), the conduction heat-absorbing capacity stands at 84 calories per cubic metre-second, which is, except for the cold winter wind of Edmonton, in Canada, the greatest in the whole series. It is probable that heat loss by vaporization of sweat would play no part in the refrigeration, for

TABLE III.
Tabulated Series of Winds.

Number.	Place.	Date.	Time.	Direction of Wind.	Temperature (Centigrade.)	Humidity (Percentage.)	Pressure (Millibars.)	Wind Velocity (Metres per Second.)	Heat-absorbing Capacity per Cubic Metre-Second.		
									By Conduction.	By Vaporization.	Total.
I	Edmonton.	January 4, 1911.	8 p.m.	W.	3.33°	81	922.8	16.09	130	306	436
II	Marseilles.	July 17, 1913.	6 p.m.	N.W.	24.0°	40	1005.4	14.31	36	243	279
III	Cairns.	February 9, 1927.		S.S.E.	24.44°	95	987.1	35.76	84	328	412
IV	Sydney.	June 9, 1929.	3 p.m.	W.	16.11°	34	1007.5	13.4	65	269	334
V	Sydney.	December 3, 1929.	3 p.m.	W.S.W.	26.44°	29	1004.7	6.20	11	111	122
VI	Sydney.	December 14, 1929.	12 noon.	E.	25.28°	80	999.7	0.9	2	10	12
VII	Sydney.	December 14, 1929.	3 p.m.	W.N.W.	32.89°	26	995.6	13.4	0.4	212	212
VIII	Sydney.	December 14, 1929.	9 p.m.	S.S.W.	20.0°	81	998.0	15.65	57	218	275
IX	Sydney.	December 25, 1929.	3 p.m.	S.E.	24.44°	81	1007.5	6.71	21	76	97
X	Sydney.	December 27, 1929.	9 a.m.	S.	22.22°	50	1013.5	1.8	6	30	36
XI	Sydney.	December 27, 1929.	3 p.m.	E.	23.33°	88	1009.8	0.9	2	10	12
XII	Sydney.	December 27, 1929.	9 p.m.	N.E.	23.33°	86	975.6	1.9	5	20	25
XIII	Sydney.	February 22, 1930.	9 a.m.	N.W.	33.89°	40	1005.1	11.18	-3	140	137
XIV	Sydney.	February 22, 1930.	3 p.m.	W.N.W.	40.39°	25	1004.0	10.28	-20	135	115
XV	Sydney.	February 22, 1930.	9 p.m.	W.	27.22°	80	1005.4	11.62	18	109	127
XVI	Sydney.	February 23, 1930.	9 a.m.	S.S.E.	23.33°	68	1014.9	7.15	13	101	114
XVII	Sydney.	February 23, 1930.	3 p.m.	S.E.	21.0°	67	1016.3	6.26	22	95	117
XVIII	Sydney.	February 23, 1930.	9 p.m.	E.S.E.	19.94°	68	1021.7	5.36	20	86	106
XIX	Sydney.	March 2, 1930.	3 p.m.	N.E.	24.22°	64	1022.0	8.05	20	112	132
XX	Sydney.	January 14, 1939.	1 p.m.	W.	47.22°	4	996.9	6.26	-23	142	119

COMMENTARY ON RESULTS.

The figures show how great are the differences in character that may exist in winds, notwithstanding that the ordinary thermometer reading may show nothing to suggest it. We have been accustomed to pay great regard to differences in the level of the temperature. The figures tell us a great deal more than that, as indeed they ought, being in every case the measured and coordinated resultant of four factors combined—three beside the temperature.

Let us therefore make a brief study of what we find.

The first is the middle-of-winter wind, said to be a "chinook", from Edmonton, a town 2,187 feet above sea level, and capital of Alberta, Canada. Although a chinook is described as a relatively mild wind for those parts, it is the coldest in the list. Since it is so cold, the potential heat loss from sweat evaporation does not come into the field of action, for in ordinary circumstances the skin exposed to it would not reach the threshold of sweat secretion. Its heat-removing capacity is therefore confined to the calories that would be absorbed in warming it to 33° C. The calculation shows that it reaches the high figure of 130 calories per cubic metre-second, which is twice as great as that of a winter westerly wind of Sydney set out in the same table. We may note that the correction for atmospheric pressure is most necessary for Edmonton, owing to its altitude. All the other winds are for places near sea level.

no sweat would be secreted if the skin were greatly cooled by conduction heat loss.

There is, too, another factor promoting discomfort. People accustomed to a warm climate feel cold under conditions that may seem uncomfortably warm to others accustomed to a cold climate. In this hurricane the temperature was not greatly depressed. But the tropical hurricane effect is one of great heat loss without a low thermometer reading. Provided the temperature of the air is not above 33° C., the increased air current tends to increase the removal of heat from the body by conduction.

June 9, 1929, provides an example of a characteristic type of winter wind in Sydney, the dry, cold "westerly". The one in the table is not very low in temperature, being only 16.11° C. (61° F.). But the experience, even with one such as this, is (at least to Sydney people) one of bitter cold, much colder than a mere low temperature with little wind. One finds, I think, an adequate reason for its cold discomfort in the figures shown, a conduction heat-lifting capacity of 65 calories per second, with a vaporization capacity of 269 calories per second. Vaporization heat loss would usually be prevented by the cold state of the skin induced by the conduction loss. To this rule there would be exceptions. For example, a wind like this could suddenly cause a tremendous flood of heat loss if one came out hot and sweating from a warm theatre into it without careful preparation.

December 3, 1929, provides an example of a wind blowing west-south-west from inland towards the coast in summer time. Notice that the conduction heat-absorbing capacity is small, no more than 11 calories per second, owing to its high temperature, but by vaporization it can lift 111 calories per second, owing to its dryness.

December 14, 1929, is recorded for 12 noon, 3 p.m., and 9 p.m., and is worth examining as an example of the rapid changes that can occur in Sydney. At noon the wind was east, it was hot and moist, and of very low velocity (0.9 metre per second). The total heat-absorbing capacity was only 12 calories per second, two from conduction and ten from vaporization. At 3 p.m. it was many degrees hotter in temperature, the direction had changed to west-north-west, the velocity had increased to 13.4 metres per second, and the humidity had dropped from 80% to 26%. The heat-absorbing capacity had jumped from 12 to 212 calories per second, all by capacity for vaporization, and not one by conduction capacity. At 9 p.m. the wind had again changed, and here we get a very good example of the famous Sydney "southerly buster". It had increased its saturation percentage as its temperature fell, and its velocity had increased to 15.65 metres per second (35 miles per hour). The heat-absorbing capacity by conduction had gone up from nearly nil to 57 calories per second, though the heat-absorbing capacity by vaporization was very little different from what it was in the afternoon. A heat-absorbing capacity of 57 by conduction will make the average inhabitant, used to, and dressed for, a warm summer temperature, feel uncomfortably cold, and continued exposure to it would certainly cause a disturbingly large flood of heat loss.

December 25, 1929, presents a south-east wind. Sydney is outside the trade-wind belt, but this specimen is probably very similar to the south-east trade wind of the South Pacific area, a warm, humid, ocean wind.

The worst kind of summer weather is that recorded at Sydney on December 27, 1929. It is an example of what is generally described as a "sultry", "close", or "muggy" day. The temperature was not high for Sydney summer weather, being 22.22° C. (72° F.) at 9 a.m., 23.33° C. (74° F.) at 3 p.m., and the same at 9 p.m. But the humidity, though only 50% at 9 a.m., was 88% at 3 p.m., and 86% at 9 p.m. The most important factor in the conditions was the wind, which was nearly calm all day, being south and 1.8 metres per second (four miles per hour) at 9 a.m., east and 0.9 metre per second (two miles per hour) at 3 p.m., and north-east and 1.8 metres per second (four miles per hour) at 9 p.m. The effect was to bring down the heat-absorbing capacity per second by conduction to six calories per second at 9 a.m., two at 3 p.m., and five at 9 p.m., and the vaporization calories were down to 30, 10 and 19 at the same hours. The actual temperatures were lower than that of the Cairns hurricane, but while in the hurricane the conduction heat-absorbing capacity was 84 calories per second, and the vaporization figure 328, it was only two calories per second for conduction and 10 for vaporization in Sydney at 3 p.m. on this date.

February 22, 1930, gives us readings from a hot-wind day, the wind being from north-west at 9 a.m., west-north-west at 3 p.m., and west at 9 p.m. The temperature at the corresponding hours was 33.89° C. (93° F.), 40.39° C. (104.7° F.), and 27.22° C. (81° F.). The humidity was 40%, 25% and 80%, and the wind velocity in metres per second was 11.16, 10.28, and 11.62, or in miles per hour 25, 23, and 26. The temperatures at 9 a.m. and at 3 p.m. being above 33° C., the direction of conduction was reversed, so as to transfer heat from the air to the body. It was -3 calories per second at 9 a.m., and -20 at 3 p.m. At 9 p.m. the direction of conduction was once more away from the body at the rate of 18 calories per second. This means that in the calculation of the total heat-absorbing capacity the 9 a.m. and 3 p.m. calories have to be subtracted from the vaporization calories, whereas the 9 p.m. calories have to be added. But while at two readings the transfer of heat by conduction could only be in the direction of warming the body and cooling the air, the case was otherwise with the vaporization heat. For note that, owing

to the relative dryness of the air, the heat-absorbing capacity by vaporization was 140 calories per second at 9 a.m., 135 at 3 p.m., and 109 at 9 p.m., so that the total refrigerative capacity was 137, 115 and 127 at those hours. The figures show that, provided the human subject sweated well, and provided also that the body surface was sufficiently exposed to the air current, not hampered by clothing, the conditions were favourable to the removal of a relatively enormous quantity of heat per unit of time. There can be no doubt that this is why extremely high temperatures can be borne well if the humidity is low, a good breeze blowing, and the clothing very light and open, or very scanty. Acclimatization is another potent factor in conditions of high temperature, bringing about a smaller habitual heat production, whereby less sweating becomes necessary.

February 23, 1930, was the day following that just considered. It presents what most of the inhabitants would describe as pleasant summer weather.

March 2, 1930, presents a sample of the typical Sydney summer afternoon sea breeze, the north-easter. The temperature was 24.22° C. (75.6° F.), the humidity 64%, and wind velocity 8.05 metres per second (18 miles per hour). The conduction capacity was 20 calories per second, and the vaporization capacity 112. The total potential heat-absorbing capacity, therefore, was 132 calories per metre-second. The wind is very similar to the south-east wind, also from the sea, of December 25, 1929. It is this north-east wind that was chosen, together with the west-north-west wind of 3 p.m. on February 22, to illustrate the method of calculation.

The last wind on the list, January 14, 1939, is from the hottest day ever recorded at Sydney. The maximum temperature reached was 45.33° C. (113.6° F.), about a tenth of a degree above the reading here given. The conduction heat was directed from the air to the body, warming it instead of cooling it. The whole of the heat-absorbing capacity lay in evaporation. The air being excessively dry, it was in that respect conditioned very favourably for absorbing sweat water, but owing to the very moderate wind velocity, the advantage was not what it could have been. However, with a wet skin, a good air current, and little clothing, it becomes relatively easy to bear high temperatures, if humidity is low.

Application to Comparison of Mean Seasonal or Local Climatic Records.

We can now turn to an examination of some mean monthly records. For this I have had to make use of data collected for another purpose by Sir Leonard Hill. In Special Report Series Number 32 of the Medical Research Committee, London, Leonard Hill (1919) presents an extended study of experimental work with his instrument, the katathermometer, in connexion with the subject of ventilation and open-air treatment. On page 238 of that report we find a ten-year record of meteorological observations in a London garden, at 62 Camden Square. The wind was measured at a height only one foot (30 centimetres) from the ground. About 15 feet away north-west and south-east were walls six feet high, there was an office 15 feet high about 40 feet away south-west, and there was a house about 40 feet away north-east. No records of atmospheric pressure were given. Hill applied his calculations to the data given, and obtained a set of figures to indicate a value symbolized as H , and denoting a "cooling power" derived from katathermometer experience. From the same data I have calculated the heat-absorbing capacity per cubic metre-second by conduction and by vaporization, and the combined total. The whole of the relevant figures are shown in a table here given. Hill's H figures, not being relevant, have been omitted.

On page 232 of the same report Hill reproduces a set of records from "Meteorological Observations", Radcliffe Observatory, Oxford, Volume L, 1912. This gives monthly means over a range of many years. The atmospheric pressure is given, but since the Camden Square records

¹ How the figures 140 and 135 were obtained has been shown in the exemplar. The temperature being above 33° C., the calculation is $x - y$.

TABLE IV.
Results of Calculation of Heat-Absorbing Capacity on the Mean Monthly Records Obtained at 62, Camden Square, London.

Month.	Daily Mean Temperature. (Degrees Centigrade.)	Humidity. (Percentage.)	Wind Velocity. (Metres per Second.)	Heat-absorbing Capacity per Cubic Metre-Second. (Calories.)		
				Conduction.	Vaporization.	Total.
January ..	4.3	89	0.27	2.31	5.45	7.76
February ..	4.3	86	0.27	2.31	5.5	7.8
March ..	5.8	85	0.25	2.17	5.11	7.28
April ..	8.9	77	0.27	1.91	5.18	7.09
May ..	13.7	73	0.16	0.85	2.81	3.74
June ..	15.6	74	0.15	0.75	2.62	3.27
July ..	17.8	76	0.14	0.60	2.19	2.79
August ..	17.6	80	0.13	0.57	2.00	2.57
September ..	13.1	84	0.10	0.57	1.71	2.28
October ..	10.8	88	0.16	1.04	2.87	3.91
November ..	6.6	88	0.21	1.64	4.09	5.73
December ..	5.4	89	0.26	2.13	5.16	7.29

leave this out, we shall not consider them here, and assume that the figures would not differ seriously, the altitude of Oxford not being greatly above that of London. The Oxford figures give dry bulb temperature records only, so it is not possible to calculate the vaporization capacity from them. However, within the temperature range recorded, the heat loss by conduction must be regarded as the more important one, though on summer days the vaporization function would often find opportunity. I have converted the Oxford wind figures from miles per hour to metres per second, and the temperature from the Fahrenheit to the Centigrade scale.

TABLE V.

Results of Calculation of Heat-absorbing Capacity, using Mean Monthly Records of Observations at the Radcliffe Observatory, Oxford.

Month.	Daily Mean Dry Bulb Temperature. (Degrees Centigrade.)	Wind Velocity, in Metres per Second.	Heat-absorbing Capacity per Cubic Metre-Second. (Conduction Figures; Calories.)
January ..	3.65	6.09	53.45
February ..	4.24	6.19	53.12
March ..	5.36	6.32	51.92
April ..	8.25	5.87	42.86
May ..	11.27	5.40	34.15
June ..	14.69	5.26	25.90
July ..	16.42	4.84	22.93
August ..	15.92	5.04	24.64
September ..	13.50	4.63	26.28
October ..	9.72	5.19	35.37
November ..	6.07	5.50	43.93
December ..	4.23	6.03	51.70

When we compare the two sets of records, we notice that the mean monthly temperature is almost the same in both. Not so the wind velocities. Official wind velocities are measured at a height of about 30 feet, and in a clear area unobstructed by trees or buildings. We can assume that these conditions hold for the Oxford records. The London garden figures are records made under the special conditions already described, and these conditions have reduced wind velocity to an extremely low rate. The respective wind velocities are represented graphically in the first chart (Figure I).

When we look at the figures, or at the curves in the two charts, showing the refrigerative, heat-absorbing, or heat-lifting capacity per second, we see an enormous difference between the two places, and it is very obvious that the most important and most significant factor is the wind, not the temperature. It is necessary for us to think in terms of heat, that is, in calories, rather than in degrees of temperature. The figures show what a profound difference can be made by shelter from the wind.

Ventilation.—The velocity factor acquires a special kind of importance in another way, because it is the one that is most liable to quick change, and in relation to ventilation it is the easiest to modify and direct at will, as by fans or other mechanical means. When air is only slowly moving, only a very small portion of the molecular content of a cubic metre of ventilating air is likely to

make actual contact with the body, and only a correspondingly small portion of its total heat-absorbing capacity is brought into effective action. A fan used on the air present in an inhabited room does not reduce its temperature or humidity, but it adds velocity. The greater movement increases effective contact with the body surface, enabling it to carry away more heat.

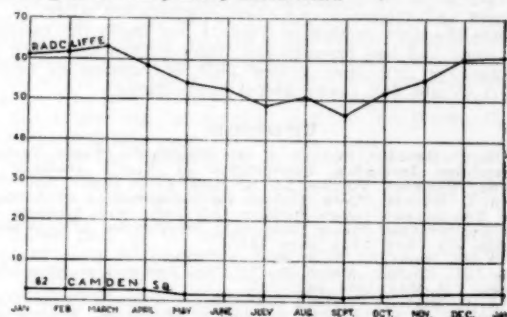


FIGURE I.

Monthly mean wind velocity as recorded at the Radcliffe Observatory, Oxford (upper curve), and at 62 Camden Square, London (lower curve).

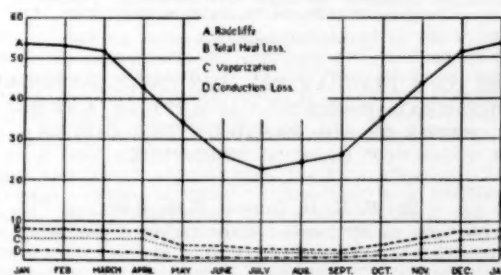


FIGURE II.

Heat-absorbing capacity of atmosphere, from body surface, per cubic metre-second at the Radcliffe Observatory, Oxford (upper curve), and at 62 Camden Square, London (three lower curves). The curve for the Radcliffe Observatory is for conduction calories only. The three Camden Square curves represent conduction, vaporization, and total calories, respectively, as indicated by inset.

SUMMARY.

A method has been worked out by which it is possible to calculate the heat-absorbing capacity per cubic metre of any sample of air in regard to the carrying away of heat from the surface of the human body.

By the application of this method to the study of a wind or other air current it has become possible to calculate its potential refrigerative capacity (heat-lifting capacity), showing separately the figures for heat that

can be taken by conduction, and for heat that can be taken by vaporization of sweat or invisible skin perspiration.

In order to make these calculations easy and to bring them within the reach of everyone, a key table (Table I) has been constructed, covering all temperatures from -60° C. to 55° C., which has made the heat-absorbing capacity of any specimen of air or wind readily calculable, so far as its effect on the surface of the human body is concerned.

The theoretical principles on which Table I is based are fully explained, and an example is given to show how the table has been constructed.

The method of using Table I is then explained, and an example is given showing how the figures for a given wind are obtained from it. In the example, a wind at temperature 24.22° C. (75.6° F.), humidity 64%, pressure 1,022 millibars (30.179 inches), and velocity 8.05 metres per second (18 miles per hour), was shown to have a heat-absorbing capacity of 20 large calories by conduction, and 112 by vaporization of sweat, total 132, per cubic metre-second.

To show better what can be done and how it may be used, the method is then applied to a number of different examples of wind, and to some meteorological records of monthly mean weather. The results obtained are set out in order and subjected to a short comparative study.

Since the construction of Table I has made the calculation easy, and has brought the study within the reach of everyone, it will open a new field of interest to many, and it should find many useful applications.

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NOTE ON A DIAGRAM FOR THE CALCULATION OF THE HEAT-ABSORBING CAPACITY OF A CUBIC METRE OF AIR, BASED ON THE TABLES OF DR. C. E. CORLETTE.

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THE diagram which accompanies this note is of the type developed by d'Ocagne and others,⁽¹⁾ and commonly applied to a very wide variety of engineering problems under the name of "nomogram" or "alignment diagram". As the latter name indicates, it is used by placing a ruler or straight-edge (preferably in the form of a fine straight line engraved on the under side of a flat strip of celluloid or other transparent material) so that it intersects the scales representing the data at the points representing their known values. The line then intersects the third scale at a point corresponding to the value of the dependent quantity.

In this case we have scales of temperature from -60° to $+55^{\circ}$ Centigrade, relative humidity from 0% to 100%, and heat-absorbing capacity from 0 to 70 kilogram-calories per cubic metre. To take a convenient example, we may consider the wind from Marseilles quoted by Dr. Corlette, in which the temperature was 24° C. and the humidity

40%. Setting a straight-edge against these values on the appropriate scales, we find that it intersects the third scale at a point representing 19.4 calories per cubic metre. This is the total heat-absorbing capacity per cubic metre under the standard conditions formulated by Dr. Corlette—namely, that the total pressure is 1,000 millibars and that the air is brought to a temperature of 33° C. and saturated with water vapour. The "conduction heat" may be read directly from Dr. Corlette's key table (Column a), and subtracted from the value read from this diagram, the "vaporization heat" being left, if the two values are required separately.

The arithmetical operations performed by the diagram may be expressed in terms of the heat quantities tabulated under the headings "a", "b", and "c" by Dr. Corlette, and the humidity fraction f , which is the percentage humidity divided by 100. Writing H for the heat-absorbing capacity per cubic metre, we have:

$$H = a + b.f + c.(1 - f)$$

This equation may be written:

$$H - f(b - c) = (c + a) = 0$$

This brings it into one of the standard forms for the construction of these diagrams. The quantities $(b - c)$ and $(c + a)$, which both depend on temperature alone, may be readily calculated from the table and from their values, and the proportions adopted for the scales of humidity and heat-absorbing capacity, the coordinates of the curve which supports the temperature scale, and the positions of its graduations were determined.

The scales of heat-absorbing capacity and of humidity are evenly divided on parallel straight lines; the total length of each of these scales on the original diagram was 14 inches, and the accuracy aimed at in the plotting of the divisions was $1/100$ inch.

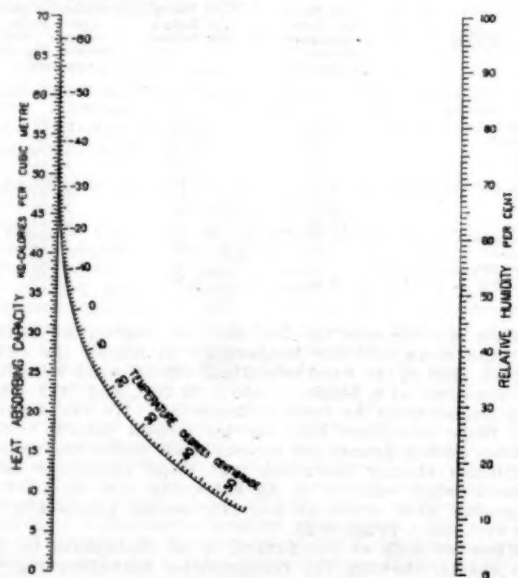


FIGURE I.

Nomogram for use with Dr. C. E. Corlette's tables. By W. H. H. Gibson, M.E., B.Sc. For use, enlarge by photography to make vertical measurement about 10 inches.

The diagram was prepared by the writer at the suggestion of Dr. H. S. H. Wardlaw, who had seen Dr. Corlette's paper, and thought that the calculations, already simplified by the tables therein, might be made still more simple if a graphical method such as this could be applied to them.

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NOTES ON THE USE OF THE TOURNIQUET.

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WORKERS in the operating theatre frequently see the tourniquet in use. Apart from the usages of war, however, its use outside the operating theatre is sufficiently uncommon to warrant a note on its dangers and a discussion of its use. It is a potent weapon both for the saving of life and for the infliction of trauma to the tissues of the limb to which it is applied. It is not an instrument to be used indiscriminately, and its employment should be reserved for cases in which simpler measures are not sufficient for the staunching of hæmorrhage, and for those operations in which blood loss is likely to be severe or in which a persistently bloody field is a deterrent to efficient and smooth work.

Whether used for hæmorrhage in the field or for operative hæmostasis, the dangers appurtenant to the tourniquet are the same, except that in the operating theatre more deliberation can be used and the person applying the tourniquet can be expected to be more experienced. The chief dangers are as follows.

Tissue Damage from Anoxia and Starvation.

Anoxia and starvation result in lowered resistance of the limb to infection and to changes of temperature, and when the limb is exsanguinated for a long time, to gangrene. The danger of gangrene is a very real one in the field, where some hours may elapse before the tourniquet is released. After the tourniquet is applied in cases of urgent hæmorrhage, the wound should be dressed and a firm pad applied, carefully fixed with a bandage. The tourniquet is loosened after half an hour, at the most, to determine whether the vessels are sealed; but the dressing is left undisturbed during this manœuvre (*vide* "Royal Army Medical Corps Manual of Training"). If this rule is strictly adhered to, death of the limb from gangrene is not likely to occur before skilled service is available.

The sensitivity of the exsanguinated tissues to heat changes is of great importance. This sensitivity persists for some time after the tourniquet has been released. The optimum temperature for these tissues is much lower than that for normal tissues. Indeed, there is some evidence to show that tissues can be exsanguinated for hours and still recover if they are kept in a cold environment, and that they can be severely damaged by heating agents which, in hospital therapy, are regarded as safe and beneficial. It is not reasonable, therefore, to apply hot water bottles and warm blankets to limbs that are recovering from a period of exsanguination. A light covering is all that they need, at the most, for the few hours following the release of the tourniquet. Artificial heat should never be applied to a limb with the tourniquet still acting.

Nerve Injury from Pressure Trauma.

Nerve injury from pressure trauma is manifested by a transient or severe paralysis of one or all groups of muscles below the point of application. It is not due to nutritional changes in the nerve from the hæmostasis, for it is not a sequela when the pressure has not been excessive. It is due to the direct effect of the force of compression on the nerve axones. The longer the period during which the tourniquet is applied, the more likely is the paralysis to arise.

Ideally the optimum pressure to apply to the limb is 10 to 20 millimetres of mercury above the systolic arterial pressure. In the operating theatre this is easily achieved with the pneumatic cuff and sphygmomanometer. In the field this apparatus is not often available. Here the same result can be secured by the use of the windlass type of tourniquet, the bandage being wound tightly till the hæmorrhage ceases. The winding should not be too rapid or the optimum point will be passed. The windlass

method can be employed with rubber tubing or strips just as well as with calico.

Commonly, of course, the rubber tubing or strip is applied on the stretch, with no gauge as to when the pressure is excessive. This is a great disadvantage. An experienced hand is necessary in such instances to obviate excessive pressure.

For the above reasons all limbs constricted by tourniquets should be regarded as "surgical emergencies" as soon as surgical service is available.

The closer the nerve is to the bone, the more it is exposed to pressure, so that the most dangerous areas are any part of the arm, the upper part of the forearm, the lower third of the thigh, and the highest part of the leg, where the common peroneal nerve lies against the neck of the fibula. Median, ulnar and radial nerves can be directly crushed between the band and the humerus. The radial nerve is very sensitive in this respect, for in the musculo-spiral groove no padding lies between it and the bone. If there is excessive pressure here, all nerves, including the cutaneous nerves, may be affected. In the upper part of the forearm the radial nerve and especially the dorsal interosseous nerve are in danger of compression. In the substance of the supinator muscle the dorsal interosseous nerve lies close to the radius. The common peroneal nerve, as it lies under cover of the biceps tendon, can easily be crushed against the popliteal surface of the femur. Application of pressure at the point where the common peroneal nerve turns round the fibula will almost surely be followed by palsy. The sciatic nerve, as it courses down the back of the thigh, can be crushed against the femur if the pressure is gross.

Therefore for hæmorrhage in the foot or lower part of the leg, the tourniquet should be applied to the middle of the leg. Its application at this point is quite efficient for control of the bleeding. For hæmorrhage in the hand or lower part of the forearm the tourniquet should be applied in the latter region. The ulnar nerve is reasonably well protected here, and the median nerve is quite safe, as it courses down between radius and ulna. Field application of a tourniquet to the thigh, especially in the lower third, and to the arm proper, must always be regarded as serious procedures. When the pneumatic cuff is used, no fear of nerve complications need be entertained if the systolic pressure is used as a guide.

Operative Use of the Tourniquet.

The following rules should be observed in the operative use of the tourniquet: (i) exsanguinate the limb as much as possible by elevation; (ii) apply the tourniquet rapidly; (iii) do not apply the tourniquet if the patient is cyanosed.

It is difficult to say for how long a limb should be elevated to obtain the maximum exsanguination, for after a time a physiological response to elevation takes place and blood volume may increase after the initial drainage. Four minutes, in practice, is a satisfactory period. Rapid application is necessary, since if the veins are occluded an appreciable time before the arteries, troublesome venous oozing impairs the smoothness and elegance of the operation. Moreover, without exsanguination a large amount of blood is removed from the systemic circulation.

The best method in the operating theatre is as follows. Elevate the limb, apply a rubber bandage from the digits to the level at which it is desired to compress the limb; roll the remainder of the bandage round the limb so as to occlude the artery; apply a pneumatic cuff just above the rubber bandage and then remove the whole bandage. The pressure in the cuff should be 10 to 20 millimetres of mercury above the systolic arterial pressure. By this method the limb is efficiently exsanguinated and there is no danger of nerve trauma.

Application of the Tourniquet in the Field.

An assistant takes the limb with both hands, exerts slight traction to steady it and elevates it sufficiently to allow of easy application of the tourniquet. In the case of a fracture the traction should be enough to make the application painless.

Paralysis.

The paralysis resulting from tourniquet pressure has a good prognosis. The nerve recovers, as a rule, more quickly than in cases of nerve section. The time required in severe cases varies directly with the distance of the application level from the muscles affected. Apart from mild fleeting palsies that may be observed, one will expect the radial and common peroneal nerves to recover in about six weeks. Rarely, complete recovery of the nerve will not take place and the limb may be gravely incapacitated. Causalgia, chronic and intractable in course, may complicate the recovery of the nerve.

The paralysis should be treated as carefully as paralysis from other causes of lower motor neurone lesion. The limb should be splinted with due regard to the prevention of muscle stretching and contracture. Proper attention should be given to maintenance of adequate circulation, and early reeducative exercises should be instituted.

Conclusion.

Tourniquets may be ranked as follows in order of surgical preference: (i) pneumatic bag with manometer; (ii) pneumatic bag without manometer; (iii) flat rubber bands, rubber strips or bicycle tubing, used windlass fashion; (iv) rubber bands or strips applied with no gauge as to pressure; (v) rubber drainage tubing, which takes too much force to stretch.

In the field, linen or calico used windlass fashion is satisfactory.

Tourniquet pressure causes great pain. Morphine should be used when available, both as a haemostatic agent and to prevent further shock from pain when the tourniquet is used as a field measure. Remember that the total pressure exerted by any tourniquet wound several times round the limb is the product of the number of turns multiplied by the pressure of a single turn.

Acknowledgement.

My thanks are due to the Deputy Director of Medical Services, Northern Command, for permission to publish these notes.

MYCOBACTERIUM TUBERCULOSIS IN MILK.

By O. KUDELKA,

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THE recent report of Webster⁽¹⁾ indicates a distinct decrease in the incidence of bovine tuberculosis of children in Victoria (Melbourne). This finding is in agreement with a similar report from Canada.⁽²⁾ While, according to Webster, in the period from 1929 to 1931 the bovine strain caused 25.9% of all cases of tuberculosis, the corresponding figure in the period from 1933 to 1941 was 8.9%. The Canadian figures are 13.5% in 1934 and 9.6% in 1938. Improvements of the milk supply by herd testing and pasteurization are quoted as the main reasons for this development, and in this connexion it seems advisable to report about 350 milk tests for the presence of *Mycobacterium tuberculosis* which were carried out during the routine control of the country milk supplied to Brisbane.

From September, 1939, up to December, 1941, bulk samples were taken from individual herds in country districts round Brisbane, the milk coming from farms where the cattle are kept under favourable conditions in wide open spaces. Farms within the boundaries of Brisbane were not examined.

Method.

Forty to eighty cubic centimetres of the herd milk were centrifuged; the sediment was dissolved in a small quantity of the milk and injected subcutaneously into guinea-pigs; two animals were used for each sample. After ten to fourteen weeks the animals were killed and examined. This relatively long time was considered necessary, as any milk containing the pathogenic bacteria is likely to be highly diluted in the bulk. Every positive macroscopic

finding was proved microscopically by the presence of acid-fast rods. It was regarded as unnecessary to consider pseudo-tuberculosis lesions such as those reported here in Australia by Dr. Albiston,⁽³⁾ since only animals with affected internal organs (liver, spleen) were accepted as giving positive evidence. To distinguish the lesions from those caused by *Brucella*, agglutination tests were carried out when necessary.

Results.

Three hundred and fifty samples have so far been examined, and 11 samples (3%) gave positive results in one or in both guinea-pigs. Of the animals injected with the samples containing tubercle bacilli, four died spontaneously and 13 were killed, both groups presenting tuberculous lesions. Two were macroscopically free from lesions, although their duplicate was affected. The rest died a short time after the injection.

The herds from which came the samples giving positive results were tested by the single intradermal tuberculin test and the reactors were destroyed.

Although special attention was paid to it, in only two cases was tuberculosis of the mammary gland reported; this disproves a widely accepted theory that only a specific process in the gland can be responsible for the presence of the bacilli in milk. As in the case of tubercle bacilli in urine sediment without any macroscopic affection of the kidneys, a mammary gland intact to macroscopic examination may discharge the pathogenic germs, especially during the frequent transient bacterial invasions of the blood stream by which the disease spreads through the body. Another important factor is the manual contamination of milk, originating from tuberculous sputum that can pass the digestive tract without destruction of the acid-fast *Mycobacterium tuberculosis*, or from cattle suffering from enteric tuberculosis.

Discussion.

There is no close relation between a milk sample containing tubercle bacilli and the number of tuberculin reactors in the herd from which it came; moreover, no certain conclusions can be drawn in regard to the intensity and extent of pathological lesions; but it must be remembered that a fairly long time passes between the taking of the sample and the result of the biological test, during which the composition of the herd may have altered.

Reports of *Mycobacterium tuberculosis* in milk vary according to country and date of examination. Calmette, in his book "Tubercle Bacillus Infection and Tuberculosis in Man and Animals",⁽⁴⁾ gives the following figures for the first decade of this century (Table I).

TABLE I.

City.	Percentage.
London (MacFadyean)	22.0
Edinburgh (Philip Mitchell)	20.0
Sheffield	10.4
Birmingham	7.3
New York (1910) (Bureau of Animal Industry)	16.0
Washington	7.0
Chicago (1910) (Tonnessen)	10.5
Berlin (Petri, Beck, Rabinowitch)	14.0 to 30.0
Leipzig (1906)	10.5
Lauterthal-in-Harz	2.53
Milan	2.00

More recent figures from England and Scotland, where the incidence of bovine tuberculosis is far higher (40% against 10%) than in Australia, are given by Gloyne⁽⁵⁾ for the County of Essex (8.2% of positive results) and Scotland (about 10%). Galger and Davis⁽⁶⁾ report 8.2% of positive results in 1931 and 8.9% in 1933. A lower figure comes from the County of Somerset,⁽⁷⁾ where only 2% of the samples were found to contain *Mycobacterium tuberculosis*.

For Australia figures are quoted from Holmes and Robertson's report⁽⁸⁾ in 1930, in which 1.7% of the milk

TABLE II.

Complete List of all Patients with Tuberculosis Treated at the Hospital for Sick Children, Brisbane, during the Five Year Period Ending June 30, 1941.

Time of Admission to Hospital.	Initials of Patient.	Site or Type of Lesion.	Remarks.
Admitted prior to July 1, 1936, and in hospital on that date..	K.H. E.L. J.L. J.M.K. O.W. D.M. F.C. C.D.	Hip. Hip; meningitis. Hip, knee. Hip. Hip. Hip. Hip. Hip.	Died.
Admitted during year ending June 30, 1937 ¹	N.B. E.S. A.S. I.L.	Meningitis. Meningitis. Cervical glands. Miliary tuberculosis.	Died. Died. Died.
Admitted during year ending June 30, 1938 ²	M.W. M.N. M.P. R.S.	Cervical glands. Hip. Cervical glands. Hip.	Half-caste aboriginal.
Admitted during year ending June 30, 1939 ³	T.D. F.F. C.F. N.E.	Spine and lung. Cervical glands. Spine. Hip.	Half-caste aboriginal.
Admitted during year ending June 30, 1940 ⁴	D.McD. D.R. E.B.	Mediastinal glands. Lung. Cervical glands.	
Admitted during year ending June 30, 1941 ⁵	R.B. A.M. M.C. R.G. J.R. L.K.	Cervical glands. Cervical glands. Spine. Hip. Cervical glands. Meningitis.	Aboriginal. Died.

Total: 29 cases.

¹ Total number of in-patients, 4,908.² Total number of in-patients, 5,126.³ Total number of in-patients, 4,731.⁴ Total number of in-patients, 4,847.⁵ Total number of in-patients, 5,504.

samples examined in Victoria contained *Mycobacterium tuberculosis*. In the same report Holmes stresses the particularly low incidence of tuberculosis in Queensland compared with the other Australian States. The only members of the population most likely to be affected by the bovine strain are children. Table II gives statistics of all cases of tuberculosis among children who were inmates of the Hospital for Sick Children in Brisbane during the last five years. The figures were supplied by the kindness of the medical superintendent, Dr. F. Arden.

Hospital figures regarding a disease that does not invariably demand admission to hospital are significant only up to a certain limit. Nevertheless they indicate a remarkably low incidence of tuberculosis in Queensland—8 cases per 10,000 children. The Royal Alexandra Hospital for Children in Sydney reports for the same period 101 cases of tuberculosis among 10,000 patients. An analysis of these figures shows that per 100 tuberculous children the incidence of tuberculosis of bones and joints was in Brisbane 52% and in Sydney 69%; the incidence of tuberculosis of the cervical glands was 23% in Brisbane and 15% in Sydney. While the tuberculosis of bones and joints, according to recent reports in Australia and from America, is caused by the human type of infection (English and Scottish figures differ from that finding), tuberculosis of the cervical glands is attributed to a very high degree to the bovine strain. Webster, in his most recent report, found 43.5% of diseased cervical glands and tonsils to be infected with the bovine strain, against 67.7% in his previous report.

Webster and many other authors hold that herd testing and pasteurization are mainly responsible for the lowered incidence of bovine tuberculosis in man. Holmes brings forward the interesting theory that climatic conditions in Queensland compel the people more than elsewhere to boil milk in order to increase its keeping quality, thus destroying any pathogenic germs.

Griffith and Smith⁶ reported that the north-eastern districts of Scotland had twice as many patients suffering from bovine tuberculosis in comparison with Aberdeen, where 80% of the milk supply is pasteurized.

In spite of the low morbidity of tuberculosis here in Queensland, the presence of tubercle bacilli in 3% of herd

milk samples involves a potential danger that can become manifest when conditions are suitable. The number of patients with specific adenitis in Brisbane may have some significance.

Strictest vigilance, combined with an energetic policy of herd testing and the encouragement of pasteurization, will eradicate one of the few evils we have the power to overcome.

Acknowledgements.

I wish to acknowledge the helpful collaboration of Mr. J. Shilkin, veterinary surgeon, Department of Agriculture and Stock, who supplied the pathological reports; of Dr. E. H. Derrick, of the Department of Health, who gave me useful information; and of Dr. F. Arden, superintendent of the Children's Hospital, Brisbane, who furnished the hospital figures.

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- ⁶ S. H. Gaiger and G. O. Davies: "Bovine Tuberculosis: Biological Tests of Milk", *Veterinary Record*, Volume XIII, Number 36, 1933, page 874.
- ⁷ E. J. Pullinger: "The Incidence of Tubercle Bacilli and *Brucella Abortus* in Milk", *The Lancet*, Volume CCXXVI, May 5, 1934, page 967.
- ⁸ M. J. Holmes and W. A. N. Robertson: "Bovine Tuberculosis in Man and Animals in Australia", *Report of the Federal Health Council*, Fourth Session, March 11-13, 1930, page 8.
- ⁹ A. S. Griffith and Y. Smith: "Bovine Phthisis: Its Incidence in North East Scotland", *The Lancet*, Volume CCXXXIV, March 26, 1938, page 739.

THE OPERATIVE TREATMENT OF HYPERPHORIA.

By E. TEMPLE SMITH,
Sydney.

HYPERPHORIA of small degree is very common. In most cases the impulse for binocular vision enables it to be overcome by unconscious effort. In some persons advancing age or illness makes this effort conscious; fatigue ensues, then pain—Nature's protest against undue fatigue—in the form of headache becomes constant, often with extreme nervous discomfort. This can then be remedied by the judicious use of prisms. I have given comfort by the use of a six-dioptre prism in each eye, but this is unusual. When so heavy a prism is needed operation is probably the better treatment, any small residuum being then corrected by a small prism.

Incidentally the condition would be more fitly called hypophoria, as the hyperphoria is merely a consequence of a weakness of the opposite superior rectus, the delinquent muscle.

In the past I have several times taken the easier way of tenotomizing the opposing tendon. I am sure this is a mistake. There is so much guesswork about it that one is apt to produce a hyperphoria of the same or greater degree in the opposite eye, with possibly diplopia, and the affair becomes a regular see-saw. The faulty tendon, that of the hypophoric eye, is the one that should be dealt with.

Report of a Case.

A recent case met with was that of K.R., aged twenty years, who had been rejected as an air pilot with vision of $\frac{5}{8}$ in each eye, because he had 2° of right hyperphoria (really 2° of left hypophoria). In addition, he had overaction of the right inferior oblique. This latter was not the cause of the hyperphoria, but the left hypophoria was the cause of the oblique overaction. The weakness of the left superior rectus was due probably to a birth hæmatoma, as I have previously hypothesized.⁽¹⁾ It was obvious that severance of the inferior oblique, though on general grounds called for, would not remove the hyperphoria in the primary position, which was due to the weak action of the left superior rectus.

In civil life this boy would have needed no treatment, as he had no conscious discomfort. Later in life, when fatigue arose, prisms would have made him comfortable. As an air pilot that was inadmissible. Operation was then decided on. The right inferior oblique was exposed, a short piece was excised, and the wound on the cheek was closed. As I expected, a Maddox rod test showed the hyperphoria to be unaffected in the primary position. At the same sitting I then performed a very small advancement of the left superior rectus. With the Maddox rod he now had a left hyperphoria. The central stitch was removed and the lateral ones were slackened. On the second day he had still left hyperphoria and also diplopia. I removed both the remaining stitches forthwith. At the end of a week he had orthophoria and no trace of diplopia. The upshoot of the right eye on looking up and to the left had also of course disappeared. He will now, I have no doubt, be accepted for pilot training.

Comment.

Several points emerge. One is that it is the delinquent tendon that should be dealt with by advancement, and not the opposing one by tenotomy. Another is that for so small a deviation as 2° (four prism dioptres) a very small advancement indeed is indicated.

A third point is this: I feel convinced from my own observation that the superior rectus paretic so often met with, which results in hypophoria with its attendant sequelæ—headache, head-tilting and sometimes squint—is probably caused by hæmatoma in the region of the brow from forceps delivery.⁽²⁾ It may be quite impossible to avoid this; in fact, I do not see how it can be avoided in a difficult delivery, and I do not think the practitioner is to be blamed. But it is worth bearing in mind that bruising in the orbital region may carry with it results much more far-reaching than a mere "black eye".

Do not let it be thought that I am advocating operation for hypophoria as a routine measure; I am not; but I thought that in the exceptional case which does call for operation these personal experiences might have some interest.

References.

⁽¹⁾ E. T. Smith: "Ocular Torticollis: Inferior Oblique Section and its Indications", *THE MEDICAL JOURNAL OF AUSTRALIA*, September 2, 1933, page 307.

Reviews.

SEASONAL INFLUENCES ON GROWTH, FUNCTION AND INHERITANCE.

A. B. FITT, in his book "Seasonal Influence on Growth Function and Inheritance",¹ has collected a body of evidence which shows that there is a fluctuation in physical growth, memory and cancellation performances, muscular capacity, mortality and disease resistance, and several other human capacities. He then gives a review of some of the work which has been done on the variation of endocrine activity in relation to seasonal changes, and finally an hypothesis of varying biological stress is adduced as the basis for the variation which he has shown.

The quantitative data in the earlier part of the book do not tell a clear story in that the variations are not shown to be independent of alteration of environment other than seasonal change. The application of statistical method to these figures is not very clearly nor thoroughly set out, and the author appears to accept a high probability as almost constituting proof of association. He gives no results for statistical testing of any other hypothesis than that which he advances. In such circumstances one is left with the feeling that the quantitative data are worth while, but that much more testing of the hypothesis and other hypotheses must be done before his tentative conclusions can be accepted. Only then will the applications which he indicates in his final chapter be worth putting into practice.

A TEXT-BOOK OF SURGERY.

THE third edition of Illingworth's "Short Text-Book of Surgery" is a war edition, and the chief change is a rewriting of the chapters on injuries.² The section on wound treatment describes briefly and clearly the best of present-day methods. It is an admirable chapter and could be profitably studied by all who may be faced with the treatment of severe injuries. Perhaps its only weakness is an omission to discuss the time factor in deciding upon closure or non-closure of the wound.

Tourniquets are applied to arm or thigh, whereas they should be applied as near the wound as possible, even if this be in forearm or leg.

The illustration of Braun's splint shows Böhler's modification, and Thomas's knee splint is used in a way that would not please the Liverpool school.

The importance of elevation is not mentioned in the treatment of hand injuries and is not sufficiently stressed in infections of the hand. The doses recommended for gas gangrene antiserum are several times smaller than the official doses. Under facio-maxillary injuries the old four-tail bandage has not yet been replaced by the barrel bandage. Under thyreo-glossal fistule the relationship of the tract to the hyoid bone is given incorrectly.

Acute pancreatitis is described as "acute neurosis of the pancreas"—no doubt a misprint—and Grey Turner's sign, sometimes of diagnostic value, has not been mentioned.

These faults are found only in the hope of still further improvements in an already excellent text-book.

Apart from injuries, the new chapter on "Safety Factors in Surgery" is the chief alteration. It takes its place as the first chapter, and, fittingly enough, on the first page of the book the student is urged to assess his patient, after a thorough examination, from the broad medical point of view.

¹ "Seasonal Influence on Growth Function and Inheritance", by A. B. Fitt; 1941. Wellington: New Zealand Council for Educational Research. Demy 8vo, pp. 193, with diagrams. Price: 10s. 6d. net.

² "A Short Textbook of Surgery", by C. F. W. Illingworth, M.D., Ch.M., F.R.C.S. Ed.: Third Edition; 1942. London: J. and A. Churchill Limited. Royal 8vo, pp. 702, with 12 special plates and 201 illustrations. Price: 27s. net.

The Medical Journal of Australia

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THE SURGERY OF MALIGNANT DISEASE OF THE RECTUM.

THOUGH many persons feel that they cannot approve of the increasing tendency to specialization in small sections of medical practice, there is no denying the fact that the branch of surgery known as proctology has received recognition as a field of special study. The Royal Society of Medicine in London has its Section of Proctology, at the annual meeting of the American Medical Association there is a Section on Gastro-Enterology and Proctology, and in London the name of Saint Mark is associated with a hospital devoted entirely to diseases of the rectum. Of all the conditions that may affect the rectum, malignant disease is probably more discussed than any other. In this it is somewhat like cancer of the stomach. Though these two forms of cancer present problems that are in many respects similar, one important difference must be noted—it has been mentioned so often that it may seem unnecessary to mention it again, but clinical experience shows that the obvious is not always seen and lesions easy of demonstration are by no means always found. In cancer of the stomach diagnosis may be suspected simply enough, but a confirmation of the suspicion is not so readily obtained. In cancer of the rectum the clinician can clinch the diagnosis without any trouble if he will examine the rectum with his finger. But if cancer of the rectum has its simple side it also presents one of great difficulty, its surgical removal. For the successful excision of a rectal cancer extraordinary skill is needed. It would indeed be correct to say that in few surgical procedures is the general surgeon given greater opportunities to display his technical ability. So also it is true that in few situations will the "occasional surgeon" be able to do more damage, potential and actual. In this regard it is interesting to recall the look of surprise on the face of one of Australia's most gifted surgeons when after the successful removal of a rectal cancer he was told by a

visitor from another capital city that he was a menace to rectal surgery. "Yes, you make it look so easy, so straight forward, that surgeons without sufficient knowledge or skill will try to copy you." In the circumstances the student of medical literature is not surprised to find on reference to the *Quarterly Cumulative Index Medicus* that the number of articles in the journals of the world on cancer of the rectum does not appear to become any less.

This subject, which, we may conclude, is evergreen, may be discussed from several points of view. First of all we must recognize unfortunately that many sufferers from cancer of the rectum are seen first by a surgeon when the disease has reached a fairly advanced stage. A decision has then to be made whether removal should be attempted, whether colostomy should be performed or whether nothing should be done. To these questions some surgeons will add another—whether some form of irradiation therapy should be used. Some indication of what will happen when nothing is done was given in a study by E. M. Daland, C. E. Welch and L. Nathanson¹ discussed in these columns in the issue of April 25, 1936. These authors studied one hundred patients suffering from cancer of the rectum who received no treatment at all. As was pointed out in reference to this study, it was most important to know why the patients remained untreated. The reasons unfortunately could not be stated with certainty. Some patients were too old or in too poor condition. Some were deterred by thoughts of a colostomy or by the magnitude of a radical operation. In some instances the disease was too far advanced when the patients first sought advice. In other instances the medical advice received by the patient before his admission to hospital had been "poor". Among the one hundred patients there were fifty-six males and forty-four females. The average age of these persons at the onset of symptoms was 59.6 years and the average length of life after the onset of symptoms was 17.2 months. These figures are clearly not particularly valuable, unsupported as they are by full clinical and pathological data, but for all that they give a general indication of what may be expected if no treatment is adopted. H. B. Devine quotes figures of survival after operation that are encouraging.² Lockhart Mummery reported a five-year survival rate of 52% among 142 persons who recovered from operation. Gabriel, Dukes and Bussey also investigated the follow-up records of Saint Mark's Hospital, London. In Group A cancer of the rectum, those cases in which the growth was removed by perineal excision before there was time for growth to extend to the perirectal tissues, the survival rate was 91% after five years. In Group B, that in which the growth had extended by direct spread to the perirectal tissues but had not reached the glands, the survival rate was 54% after five years. In Group C, in which glandular metastases were present, the survival rate after five years was 16%. The incidence of tumours of the three groups described by Gabriel, Dukes and Bussey among patients submitted to operation is shown in a comparatively recent study by Dukes of a thousand tumours removed by radical operation.³ Of the

¹ E. M. Daland, C. E. Welch and L. Nathanson: "One Hundred Untreated Cancers of the Rectum", *The New England Journal of Medicine*, March 5, 1936, page 45.

² "The Surgery of the Alimentary Tract", page 1008.

³ Cuthbert E. Dukes: "Cancer of the Rectum: An Analysis of 1,000 Cases", *The Journal of Pathology and Bacteriology*, Volume L, 1940, page 527.

one thousand tumours, 15% belonged to Group A, 35% belonged to Group B and 50% to Group C. From the point of view of diagnosis it is important to note that in Dukes's study most cancers of the rectum when surgically removed, had the form of oval ulcers two to three inches in diameter and extending over two or three quadrants of the rectum. From our present discussion three points emerge. The first is that although cancer of the rectum is one of the more slowly growing forms of malignant disease, surgical treatment will give the patient a much longer expectation of life than if he has nothing done. The second is, as would be expected, that the patients most likely to survive for long periods after operation are those whose tumours have not extended into the perirectal tissues. The third is that among tumours removed at operation those most favourable to a long survival period are by far the fewest in number. The whole question again boils down to one of early diagnosis; and diagnosis may here be considered from two points of view. In the first place when the patient seeks advice for any symptoms that can in any way be referred to or associated with a possible rectal condition, there is no excuse for failure to make a diagnosis. All practitioners will agree with this kind of *ex cathedra* statement, but even so it is unfortunately a fact that cancers of the rectum sometimes almost proclaim their presence and are not diagnosed because the practitioner will not make a digital examination of the rectum. From the second point of view, that of the patient who has no symptoms referable to the rectum, the matter is by no means so simple. Cancer of the rectum occurs mostly in persons over the age of forty years—only 71 of Dukes's thousand cases occurred in persons below that age. It is also true that at the time of surgical treatment the disease is likely to have spread more extensively in young patients than in the middle aged or elderly. It appears then that if early diagnosis of cancer of the rectum is to become general, examination of the rectum must become part of the routine clinical investigation of all patients and also of all members of the community who in ideal circumstances would be examined regularly to see whether they were in good health.

Brief mention must be made of treatment, though that falls into the hands of the specialist rather than of the general practitioner whose chief concern is diagnosis. As already indicated, the excision of a cancer of the rectum is a formidable procedure. We do not propose to discuss the several types of operation, but would point out that as a rule radical removal is preceded by the establishment of an artificial anus. Devine, in his book on surgery of the alimentary tract, makes a good case for radical operation on what he calls a defunctioned colon. By this he means a colon which has been completely disconnected from the alimentary canal so that it cannot be soiled in any way by even the smallest quantity of faeces, one from which the faecal contents have been washed out, and one which has been allowed to remain functionless until such time as the bacterial content has been considerably reduced. This will appeal to most surgeons as an eminently sensible idea. As a matter of fact at a recent discussion at a meeting of the Section of Proctology of the Royal Society of Medicine on the factors which make for safety in the pre-operative and post-operative treatment of carcinoma of the rectum J. A. MacFarlane mentioned Devine's pro-

cedure.⁴ He said: "In the eighteen months preceding the war some experience was gained with the Devine operation, and several growths in the lower sigmoid were resected. It is felt that this procedure should be the one of choice in those growths above the peritoneal reflection, yet too low to permit of a Mikulicz resection . . . there is no doubt that after thorough washing of the distal loop after a transverse colostomy of the Devine type, an anastomosis of colon to rectum can be done with safety, and the sphincter function saved." G. Gordon-Taylor at the same discussion remarked that of all pre-operative measures determining the success of a rectal extirpation none was more important than preliminary drainage of the bowel. Complete defunctioning of the bowel is a more thorough procedure than drainage. A great deal more might be written regarding the preparation of patients for operation and the type of operation. This must be deferred to a future occasion. In the meantime readers will find much interest in the report of the discussion at the meeting of the Royal Society of Medicine; those whose immediate concern is operative technique will find their needs met by the last four chapters in Devine's book.

Final reference must be made to colostomy as a palliative procedure. Daland, Welch and Nathanson showed⁵ that colostomy does not prolong life to any appreciable extent. They also concluded, and most clinicians will agree with them, that a well-functioning colostomy opening is much easier to care for than an incontinent rectum. It is only fair to point out that the value of colostomy in non-obstructive cases of inoperable carcinoma is not always accepted without question. Ff. Roberts holds⁶ that except in advanced cases X-ray treatment provides a method of restoring rectal function to a degree compatible with an active life for a considerable period without resort to colostomy. It has, he holds, the further advantages of causing the minimum of discomfort and avoiding any operative procedure. There are many who will not accept this view. The truth of the matter is that, as already pointed out, the surgery of malignant disease of the rectum calls for extraordinary skill. We may close with the words of G. Gordon-Taylor,⁴ whose heroic exploits in surgery are well known to readers of surgical journals:

The relative percentage of cases of cancer of the rectum to which the radical or some "makeshift" operation is applicable will vary with the condition of the patient and with the skill and the experience of the surgeon. A super-surgeon will attain success where the less skilled or less experienced courts failure; thus an obvious pre-operative factor in determining success is the choice of a surgeon of experience, of skill and especially of judgment.

Current Comment.

STAPHYLOCOCCUS AUREUS BACTERIÆMIA.

Not so many years ago there were medical observers in this country who believed that the staphylococcus seldom if ever gave rise to a fatal septicæmia. Even the findings of Kellaway, MacCallum and Tebbutt published in 1928 after the dire calamity known as the Bundaberg

⁴ *Proceedings of the Royal Society of Medicine*, September, 1941.

⁵ Ff. Roberts: "X-ray Treatment of Inoperable Carcinoma of the Rectum without Colostomy", *The British Medical Journal*, March 8, 1941, page 357.

disaster were accepted with reluctance by these persons. Since that time, however, clinical observation and laboratory investigations of animal infections have incriminated the staphylococcus beyond any shadow of doubt. The subject may be approached from two points of view—the clinical and that of the laboratory. The practising medical man or woman will be interested chiefly in the clinical aspect, and this is easily understood. At the same time he or she cannot afford to neglect the experimental work that has been done on so important a subject. In these circumstances attention is directed to an important study reported by David Skinner and C. S. Keefer from the Boston City Hospital and the Department of Medicine of the Harvard Medical School.¹

These observers have studied 122 cases of bacteriemia caused by *Staphylococcus aureus* and have reviewed the literature concerned with experimental infection in animals. At the outset it may be explained that the clinical study made by these authors reveals two facts, not always realized by clinicians. The first is that the condition is extraordinarily fatal, and the second that treatment is unsatisfactory, even chemotherapy not yielding the results expected of it. The 122 cases occurred in patients who were observed at the Boston City Hospital over a seven-year period. In every instance the patient had a demonstrable bacteriemia on one or more occasions, and the clinical course was entirely consistent with a severe infection. Only 22 of the 122 patients recovered, the mortality rate thus being 81.97%. The ages of the patients varied from ten weeks to seventy-two years, but most of them (67.2%) were under forty years of age. In 57% of the cases the bacteriemia occurred during the second, third or fourth decade, the greatest number being in the second. Of the 40 patients over forty years of age, only one recovered, and on the other hand 77% of the recoveries occurred among patients younger than thirty years of age. As might be expected, the commonest port of entry was the skin, and then in order came the respiratory tract, bone and the genito-urinary tract. In 12 instances the port of entry was not determined. In 57 cases the organisms gained entrance through the skin, and in 24 the infected area was situated on the face, head or neck. In only one case of these 24 did the patient recover—he had a carbuncle of the neck. Of the 57 skin infections, 30 were manifested as boils and carbuncles, 14 as infected wounds, nine as infected vesicles, two as areas of cellulitis, and two as infected areas of arteriosclerotic gangrene. A point of practical importance is that in 17 cases it was clear that the bacteriemia followed a rupture of the local defence mechanism—in ten the primary abscess was incised; in seven the infected area was rubbed, squeezed or picked. In 30 cases the port of entry of the organism was in the respiratory passages. Of these cases it may be noted that there were 20 in which patients had infection of the upper respiratory passages and only three of them recovered; five patients had primary pneumonia and all died. In the 11 cases of primary osteomyelitis no history of a preceding staphylococcal infection was obtained; in five of the 11 there was a history of mild trauma. In 11 cases the organism entered by way of the genito-urinary tract. In three cases the condition was puerperal sepsis; in the case of two male patients bacteriemia appeared after urethral instrumentation. Skinner and Keefer could find no definite correlation between the port of entry and the outcome of the case. Perhaps some correlation may be seen in the fact that lesions in the skin are likely to be interfered with by the patient who in an excess of zeal may break down the barrier of local defence. Of course breakdown of the local defence mechanism is not the only factor which will influence the onset or the course of the bacteriemia. Skinner and Keefer find that other factors include trauma, diabetes mellitus, arteriosclerosis, heart disease and cancer. Naturally, when the defence mechanism has time to come into play recovery is more likely to occur. Skinner and Keefer found that the infection of all the patients who recovered became "focalized" into an abscess amenable to surgical treatment. But this infection is acute and lethal. The majority of the patients

in Skinner and Keefer's series who died, died before the tenth day of illness; the illness of those who recovered ran a protracted course. The most constant feature of the illness was a high remittent fever which abated after the surgical treatment of an abscess.

This brings us to the question of treatment. Skinner and Keefer remark that the treatment adopted varied from year to year (the period was seven years). This may be an indication either that treatment was not particularly satisfactory or that the clinicians followed therapeutic fashions. Probably the former was the reason—the results of treatment, as we have seen, were bad and naturally more satisfactory methods would be sought. The figures are interesting. Of 75 patients who received general treatment only, 63 died; of 42 who received general treatment and chemotherapy, 33 died. Skinner and Keefer quote the percentage figures for these two groups—84 and 78.6. How far the use of percentages in connexion with these two groups is justified must be regarded as doubtful. Though there was probably no selection in regard to which patients were given general treatment only and which chemotherapy in addition, there is nothing to show that severe infections did not predominate in one group or the other. It is most likely that chemotherapy was used in the later infections. For all this, the general conclusion is justified that treatment is unsatisfactory. Skinner and Keefer obtained their best results by drainage of an abscess, when possible, and by blood transfusions. Since abscesses form only in the later stages of the infection and in those who are likely to recover (whose defence mechanism has been active), opening of an abscess would be more likely to be followed by a good result than when no abscess could possibly be opened. In practice most clinicians would be certain to adopt chemotherapy unless it was contraindicated, and they would undoubtedly be right in doing so; but they would also use general measures and blood transfusion in certain cases. Skinner and Keefer, if they do nothing else, show that it is impossible to say that this or that form of treatment is the only one to be adopted.

On the laboratory and experimental side of their study Skinner and Keefer show that the virulent staphylococcus contains a type-specific carbohydrate, possesses a capsule and is capable of elaborating toxic substances which are named according to their properties, such as hemolytic, dermatonecrotic and intravenous lethal factors, leucocidin and coagulase. They point out that no definite conclusion has yet been reached as to whether there is a single toxin with hemolytic, dermatonecrotic and lethal manifestations rather than three separate and distinct toxins. They mention work by Burnet, by Bryce and Rountree, and by Levine on the unitarian side, and work by Burky and by Forssman on the other side.

The course of the infection in man and the course in laboratory animals are parallel and are classed by Skinner and Keefer into the following four types: (a) bacteriemia without metastatic infection and with rapid death, (b) bacteriemia with metastatic infection, and death, (c) clearance of bacteriemia with focalized metastatic infection and death, (d) clearance of bacteriemia with focalized metastatic infection and recovery.

THE BLOOD PICTURE IN RHEUMATIC FEVER.

"We hoped to shed new light on this malady, which is so obvious in its acute manifestations, so elusive in its subacute state, and so charged with uncertainty when it is quiescent." With these words Valentina P. Wasson, Edward E. Brown and Clarice Weintraub begin the description of observations upon the blood of one hundred rheumatic children.¹ This series comprised 53 girls and 47 boys, of an average age of ten and a half years, upon whom a total of no less than 7,487 investigations were performed. The authors conclude that their studies are of little value in the management of a new, undiagnosed

¹ Archives of Internal Medicine, November, 1941.

² American Heart Journal, September, 1941.

example of the disease, but are of very definite value in the prognosis of the course to be taken by an established rheumatic infection.

The first results described are those of the application of the erythrocyte sedimentation test, already accepted as probably the most delicate indication of rheumatic activity. A seasonal rise in the rate was recorded for the whole group in November and March, the usual times of greatest incidence of acute rheumatism in the United States of America. Dividing the children into acutely ill and quiescent groups, Wasson, Brown and Weintraub found a mean erythrocyte sedimentation rate in the former of 24.7 millimetres per hour (normal, 10.0 millimetres per hour), and in the latter of 8.05 millimetres per hour. The deviation from normal in the group of children who were well, depending upon menstruation, colds *et cetera*, did not exceed 2.0 millimetres. The next criterion investigated was the non-flament neutrophile count, for which the Schilling technique was adopted. After four years' observations of the total leucocyte count as an aid to prognosis these authors have abandoned it as valueless. Previous observers have usually considered that the Schilling count followed the rise and fall of the acute phase rather than that of the quiescent interval. Wasson and her co-workers made 1,193 Schilling counts over a period of thirty-two months. The average percentage of non-flamented cells was 8.4. A striking parallelism was observed, both in seasonal incidence and in the individual patient, between the Schilling count and the erythrocyte sedimentation rate, the latter tending towards the normal level later in convalescence. During acute rheumatic fever 54% of children showed a moderate "shift to the left", while only 13% showed a marked "shift to the left". The erythrocyte sedimentation rate showed itself to be the more sensitive of the two tests, rising earlier and falling later in an acute attack, but none the less subject to certain extraneous influences, such as menstruation.

The hæmoglobin content of the blood in rheumatic fever has received scant attention in medical writings, although all are agreed that anæmia is a common accompaniment of the rheumatic infection in childhood. In this inquiry the Sahli method was used to estimate hæmoglobin in grammes. In three successive winters the hæmoglobin value of the blood of the whole group fell progressively. This was in accordance with increasing numbers of attacks of acute rheumatism, and increasingly severe New York weather. The average hæmoglobin percentage of the acutely ill patients was 69.6, and of the quiescent group 73.35. Wasson and her co-authors conclude that too many other factors continue to determine hæmoglobin content to allow much reliance to be placed on this test in diagnosis or prognosis.

Of the 100 children of this series, 43% had more than two attacks of epistaxis, and a lesser number showed petechial spots or purpura. This invited an inquiry into a series of estimations of blood platelets, bleeding time and coagulation time, especially as it constitutes a sparsely cultivated gap in the knowledge of the rheumatic infection. Tocantins has written that a thrombopenia develops coincidentally with the duration of fever. No other writer, it is stated, has referred directly to rheumatic fever. In twenty months 824 platelet counts were made on 100 rheumatic patients and only 4.38% had counts above 250,000 per cubic millimetre; 67% of counts were below 200,000 per cubic millimetre, which is low by all standards. A seasonal inversion to the erythrocyte sedimentation rate and Schilling counts could be perceived. The platelet count of the acutely ill children was on an average 7,300 cells lower than that of the children whose disease was quiescent. At the outset of an attack the number of platelets fell moderately, then more rapidly, and quickly returned to normal at its termination. Coagulation and bleeding times were within normal limits. Seeking further for an explanation of the purpuric phenomena observed, Wasson, Brown and Weintraub investigated capillary resistance by means of an instrument known as the Dalldorf capillary resistometer, apparently an instrument whereby skin capillaries are subjected to the sucking effects of a vacuum applied

to the skin. Normal capillary resistance is stated under these conditions to be represented by 23 centimetres of negative pressure. The average among the rheumatic patients under review was 17.07 centimetres of negative pressure (ill children 16.55 centimetres, children with quiescent disease 17.3 centimetres). Those patients with purpuric phenomena showed the least capillary resistance.

The seven tests investigated by this group may be placed in the order of utility and diagnostic significance. The estimation of the erythrocyte sedimentation rate is the most delicate or perhaps too delicate a means of detecting an infection, even a trivial one, and for following its course. The Schilling or non-flamented neutrophile count is worthy of adoption for routine use, as an increase in the number of non-flamented neutrophile cells always indicates an infection, often a severe one; and even a single test has a significance. The capillary resistance test comes next, and may prove to be of valuable diagnostic importance because of the constancy of alteration in rheumatic patients. No mention is made of any inquiry into the vitamin C status of these patients, so that the reader is left uncertain as to whether the increased permeability is an intrinsic feature of the rheumatic state or whether it is due to associated avitaminosis C. However, the authors have promised a separate communication upon their findings with this test, and doubtless such points will be elucidated.

PNEUMATIC RUPTURE OF THE COLON.

From time to time newspapers report in more or less guarded language the death of some man, generally a young man, who has been injured by a jet of compressed air released close to his body. This sort of stupid practical joke is generally perpetrated by young employees on one of their mates. Most practical jokes are intolerable, but the sudden release of a jet of compressed air anywhere near the anus of another person calls for more than censure. R. K. Brown and J. H. Dwinelle have recently discussed this condition.¹ They report three cases of their own and refer to records of sixty culled by them from the literature. It is of interest to know that the first fatal case found in the literature was one reported by Stone in 1904 in which rupture of the bowel was caused by compressed air introduced *per rectum* from a machine which was pumped by hand. In 1908, too, Petren reported a case of fatal rupture of the œsophagus from accidental oral insufflation.

Brown and Dwinelle point out that all cases of rupture of the colon by compressed air are not the result of pranks. They add that workmen should never dust their clothes with compressed air. The jets used in industry usually have a pressure of from 50 to 100 pounds or more, and the gaseous jet differs from a water jet in that it is elastic and expands in all directions, adapting itself to surroundings and causing eddy currents. Such a jet enters the anus more readily than the examining finger or the proctoscope; it passes through the clothing and enters the bowel even when not accurately directed at the anus, and it has been suggested that the thighs, buttocks and perineum form a funnel which delivers the stream of air to the anus. Rupture of the intestine seems to depend more upon the suddenness of the pressure than upon its amount; the bowel will expand enormously if given time to relax. It appears that the *muscularis mucosa* adapts itself more readily to sudden changes in tension than the outer muscular coats of the bowel. Rents in the muscle, usually along one of the longitudinal bands, with the underlying mucosa intact have frequently been observed. The inner mucosal tube balloons out through the split outer muscular tube, like the "blow-out" of a pneumatic tire. The bursting defect in the inner tube is usually smaller than the rent in the outer tube; it may retract beneath the edge of the outer tear. When multiple lacerations have occurred, usually in only a few is complete rupture through all layers found. The most common

¹ *Annals of Surgery*, January, 1942.

lesion is a complete perforation at the angulation where the sigmoid colon joins the rectum. Rarely the injury destroys the blood supply of segments of the colon. Tearing of the ascending and descending colon from parietal attachments has been noted in a number of cases. The entire intestinal canal may be filled with air. Subcutaneous emphysema of the trunk occurs when the distension is great. Diagnosis should be simple and may be made from the history alone, if this is properly elicited. Abdominal pain is immediate and may radiate to the shoulders, and the patient is usually prostrated. In severe cases the abdomen is enormously ballooned, and cyanosis follows the resulting embarrassment of respiration and circulation. The uniformity of the tympany over the entire abdomen has been considered diagnostic. On the other hand, when distension is not great, the pain may disappear from the upper part of the abdomen and the patient may be comfortable until local pain develops at the site of the perforation; obliteration of the liver dullness may be the only positive sign. Skiagrams taken with the patient erect reveal gas between the liver and diaphragm.

Discussing treatment, Brown and Dwinelle state that when distension is great, immediate paracentesis should be performed; simple relief of intraabdominal pressure may remarkably improve the condition of even moribund patients. The insertion of tubes into the rectum is of no avail, and enemata are of course never to be used. Operation should be performed as soon as possible, and the incision should be large enough for exposure of the whole of the colon. There is no need to discuss the operative procedure. Recovery is usual when only the serous and muscular coats are torn; but in the presence of one or more complete perforations the prognosis is grave unless an adequate operation is performed within a few hours.

CANADA'S WAR EFFORT.

The majority of Australian medical practitioners are doing something to further the war effort in this country. At the same time it is probable that many could do more than they are doing. It is true, generally speaking, that the busiest man can find time to undertake an extra duty—he makes plans about his work and does things in an orderly fashion; in other words he does not puddle along in a mess of half-completed jobs. When a man is doing his best in any undertaking it is always interesting and sometimes stimulating for him to know what others engaged in the same work are doing. If this is true of individuals it is also true of communities. It is therefore proposed to record some facts about Canada and her war effort as set out by James J. McCann in an address at Toronto last September.¹

McCann pointed out that the Canadian fighting forces are being well provided for, both at home and overseas. At the time when he delivered his address there were 1,024 medical officers attached to the Army; 718 of them were in Canada and 306 were overseas. There were 673 nursing sisters, 437 in Canada and 236 overseas. For the Royal Canadian Air Force there were 319 medical officers, all of whom, except eight, were in Canada. In the Navy there were 94 medical officers, 70 in Canada and 24 overseas. The personnel of the three services includes specialists. It is important to note that the medical and dental services for the personnel of the armed forces, Navy, Army and Air Force, are provided by the Royal Canadian Army Medical Corps. Canada has 72 military hospitals on the home war establishment and two in Newfoundland with a total capacity of over 5,900 beds; 33 of the hospitals are connected with training centres. For prisoners of war and internees there are 27 hospitals with a total capacity of 500 beds. In addition to these Canada has more than a thousand hospitals with 100,000 beds. These are for the civil population, but in war time can be used as auxiliary equipment for the fighting forces. For the armed forces overseas there are 17 field ambulance units and two general hospitals of 1,200 beds each; and both are overseas.

There are four general hospitals of 600 beds each (two are overseas), one neurological hospital and one convalescent depot. The number of beds available overseas last September was more than 5,000.

The total of Canada's armed forces, including the Reserve Army which is trained for home defence, was approximately 470,000 last September. Up to April, 1941, 328,325 recruits had been submitted to X-ray examination of the chest, and of these, 5,273 or 1.6% were rejected. Approximately 58% of those rejected were shown to have pulmonary tuberculosis and 21% other lung disease. However, of those drafted, approximately 12% were rejected after medical examination. In a recent recruiting campaign, in which 32,000 men were required, about 48,000 offered their services, 35,000 were accepted and the rest were rejected as medically unfit. McCann has no difficulty in finding a reason for this high rate of rejection. He puts it down to old heart disease or kidney lesions, the result of diphtheria or scarlet fever or measles, or ocular defects or stomach ulcers, which were either preventable or could have been cured had the benefits of modern medical science been available. On reading these figures we naturally ask about the available man power. McCann states that man power for the armed forces and for industry is "limited" and must be conserved. In the age group 20 to 39 the reservoir of military man power is 1,800,000, and of these probably 600,000 are physically unfit and 300,000 are on active service. This brings the pool down to 900,000. When those in industry are deducted and those who for one reason or other are not desirable for enlistment, about 500,000 are left. McCann holds that this reservoir will soon be used up and he naturally asks what measures can be taken to conserve the health of young men of military age. Among the measures which he suggests are immunization of all troops against diphtheria and examination by a serological test for syphilis of all in the fighting forces both when they enter the ranks and on discharge. Beyond this McCann discusses, as indeed he must, the general health of the people. Any reference to this must be left for another occasion.

THE EFFECT OF THE HOST ON THE PARASITE.

In the grim science of parasitology attention has not unnaturally been centred on the effects of the invader on the invaded; indeed, with the exception of endocrine disorders and the results of malnutrition, these constitute the bulk of human pathology today. From the detached biological standpoint the carrier represents a perfect balance between host and parasite; when the parasite kills the host or the host encysts and starves or otherwise destroys the parasite, there is imbalance. That the host can alter entrant and multiplying germs of disease has been known from early years of bacteriology; in many generations of development in one host the bacteria become adjusted to the specific proteins of that host and become attenuated for other species. That Koch carried this doctrine too far in the case of bovine tuberculosis is a well-known episode in medical history.

The possibility that the host can modify metazoan parasites has attracted relatively little attention from biologists. In the October, 1941, number of the *Biological Reviews of the Cambridge Philosophical Society* there appears an article from the pen of George Salt embodying the results of a research on the modifications of insect parasites produced by different hosts. The first and most obvious of the insect reactions is in body size and through its effects on size the host can influence the proportion of parts, the presence or absence of wings, the fecundity and the behaviour of the parasite. Apart from considerations of body size the rate of development can be altered and when dimorphism exists this rate can be controlled by the host. The final conclusion of the author is that in investigations on parasites the standardization of the host is necessary to obtain precise results. The article opens up an interesting vista of applied biology and it is to be hoped that further research on this topic will be undertaken.

¹ Canadian Public Health Journal, December, 1941.

Abstracts from Medical Literature.

SURGERY.

Surgical Organization in Air Raids.

C. W. F. ILLINGWORTH (*Edinburgh Medical Journal*, December, 1941) discusses surgical organization in air raids and bases his remarks on experience gained in the Clydeside raids early in 1941. There was no lack of ambulance vehicles, but transport was rendered very difficult because of obstruction to roads by craters and debris. First aid posts were found to do valuable work, and by treating lightly injured casualties greatly eased the strain on the hospitals. It was not found that the first aid post organization led to delay in the transport of the wounded to hospital. Most casualties requiring hospital treatment were taken there direct from the "incident", and the work of the first aid posts was devoted to the care of the lightly wounded, of those too severely injured to be moved further, and of those for whom transport was not at the moment available. Air raid casualties differ from the victims of peace-time accidents in being covered from head to foot in thick grime raised by the blast, and also in the frequency of severe shock. The great majority of casualties suffered from injuries due to falling masonry. Next came wounds from bomb fragments or flying splinters of glass, wood or stone. Burns were not numerous in the Clydeside raids. Finally there were many nondescript injuries, such as fractures, sprains and bruises. Among wounds, those of the face and scalp predominated; major cranial, thoracic and abdominal injuries were rare, probably because the majority of persons affected by them did not survive to reach hospital. Injuries to the eyes were common and many required specialist treatment. Casualties were distributed amongst the hospitals, and the general admission method was to sort the casualties into four main categories. The first included those requiring immediate operation (in the hospital to which the author was attached no case came within this category). The second category comprised casualties in a state of shock or with severe injuries likely to give rise to shock, and suitable for treatment at special resuscitation wards. The third included less severely injured casualties, requiring in-patient treatment, but not urgently needing operation. The fourth group included walking casualties, suitable for out-patient treatment. The presence of an experienced surgeon is desirable for the classification of patients on admission. A shock or resuscitation unit is essential, and in the Clydeside raids the resuscitation units were fully extended. It is planned that in future raids resuscitation teams will consist of a surgeon, four physicians and ten senior students. The author points out that in the early hours of a severe raid the surgeons are more usefully employed in the wards than in the operating theatre. Very few casualties are in immediate need of operation when they reach hospital. Others, who need operation less urgently, require antishock treatment before operation can be performed with safety. In the operating theatre time can be saved by an assistant in an

adjoining room, who undertakes the preliminary cleansing and shaving of the wound area. The author refers very briefly to the details of surgical treatment. He advises against tight primary suture of wounds and against the use of unpadded plasters, but favours packing with "Vaseline" gauze after local treatment with sulphamylamide and immobilization in padded plasters.

War Wounds of the Chest.

J. E. H. ROBERTS AND O. S. TUBBS (*The American Journal of Surgery*, October, 1941) write concerning their experience of war wounds of the chest seen during the first two years of the present conflict. They found that patients stood transport better than had been expected, provided that the transporting was done carefully and with the trunk raised to 30° above the horizontal plane. It therefore became customary to transfer patients who needed early operation to special hospitals, possibly twenty miles outside the centre of London. Such transfer was, of course, preceded by resuscitation, the closure of sucking wounds of the thorax, and control of external haemorrhage. Patients not requiring early operation were retained in the primary hospitals. "Blast" injury to the lungs is produced by the positive pressure wave of an explosion causing diffuse intrapulmonary haemorrhage. Clinically very few patients have been diagnosed as suffering from this condition. The authors suggest that there is only a very small margin between immediate death and complete escape from blast injury. The patient who escapes immediate death may be found to be cyanosed, dyspnoic and very shocked. Scattered pulmonary rales may be heard. There may be a complaint of diffuse chest and abdominal pain. Generalized abdominal rigidity may occur and be sufficient to precipitate laparotomy. This rigidity is thought to be due to associated bleeding from intercostal vessels irritating the accompanying nerves. Closed injuries of the thorax are usually treated conservatively, except when there is evidence of increasing intrapleural haemorrhage necessitating operation. Apart from this, such patients are treated by strapping, preferably with elastic strapping slightly stretched. The patient is rolled slightly towards the injured side in order to restrict respiratory movement. Laparotomy may be necessary if the fractured ribs are associated with an intraabdominal visceral injury. Haemothorax is treated by aspiration. If the blood is left *in situ* it is an excellent culture medium in the event of infection, and the deposit of fibrin may limit later reexpansion of the lung. The fear of restarting haemorrhage appears to be theoretical only, provided that excessive negative pressure is avoided. If complete aspiration appears likely to produce an excessive negative pressure, partial air replacement may be used, but not otherwise, as it prevents adhesions of the apex to the parietes and, should infection then occur, an almost complete empyema results. If infection does occur, treatment is the same as for empyema from other causes. Contralateral lung collapse is occasionally seen in chest injuries and may be treated by bronchoscopic aspiration if seen within twenty-four hours of the collapse. There are three objectives for which early operation should be undertaken. They are: (a) the control of progressive bleeding, (b) the con-

version of an open pneumothorax into a closed pneumothorax, and (c) the prevention of sepsis. Through-and-through wounds without indriven bone fragments are unlikely to be followed by sepsis. Small missiles less than half an inch in diameter rarely introduce infection if they enter through an intercostal space. Large fragments often carry in rib splinters or foreign material such as clothing or soil, and sepsis is very liable to follow. When open operation is performed the pleural cavity is powdered with sulphanilamide before closure. Drainage by a Malecot type of self-retaining catheter through an intercostal space, but not through the main wound, is instituted. The catheter is connected to a rubber tube passing to a "water-seal" drainage bottle. After forty-eight hours the catheter is removed and the small opening is closed by the tying of a single suture introduced at the time of the original operation.

Lumbar Puncture in Head Injuries.

M. A. GLASER (*Western Journal of Surgery, Obstetrics and Gynecology*, November, 1941) discusses conclusions reached from a study of 1,000 cases of head injury and makes particular reference to the place of lumbar puncture in regard to diagnosis and treatment. Variations of pulse, temperature, blood pressure and respiration suggest that the patient is not doing well, but are not of reliable assistance in the reaching of a decision as to whether intracranial pressure is raised. The only way to determine the intracranial pressure accurately is to perform a lumbar puncture and to take manometric readings. Provided tumour and local infection can be excluded, a rising intracranial pressure of from 300 millimetres of cerebrospinal fluid upwards, together with deepening coma and focal signs, is indicative of haemorrhage. For diagnostic purposes lumbar puncture should be repeated after an interval of four to twelve hours and is a perfectly safe procedure provided the pressure is lowered by not more than half at any one puncture and the removal of fluid is effected slowly. It is advisable when manometric readings are being made to perform Queckenstedt's test in order to exclude the presence of any spinal block. In the series of cases of head injuries under discussion the author found pressures ranging up to 500 and 600 millimetres, the pressure being slightly higher with brain injury than with intracranial haemorrhage. The author found that the necessary distinction could be made by the fact that in brain injury the pressure tends to fall again spontaneously, or if reduced by osmotherapy or lumbar tap will not rise again, whereas with intracranial haemorrhage the effect of artificial lowering of the pressure is purely temporary, and in untreated cases this falls only as a terminal event.

Diagnosis and Localization of Intraabdominal Abscess.

W. C. BECK, J. D. KOUCKY AND M. BAKER (*The American Journal of Surgery*, January, 1942) describe the use of X-ray examination in the diagnosis and localization of intraperitoneal abscess. Fluoroscopic and film examinations are made with the patient in various positions. The relation of the abscess to adjacent bowel is sometimes made more clear by the cautious injection of air into the bowel. The

authors consider the method of especial value in assisting the planning of incisions for the evacuation of pus.

Cotton as a Suture Material.

P. THOREK (*The American Journal of Surgery*, January, 1942) discusses very briefly the characteristics of various suture materials, and reports his personal experiences with cotton in a series of 150 assorted operations. Cotton is conveniently sterilized by either autoclaving or boiling. The thread used should be as fine as will provide the strength required, and the author advises number 80 for small ligatures, number 50 for intestinal and purse-string sutures, and number 24 for ordinary wound sutures. He follows the teaching of Halsted with regard to non-absorbable sutures in counselling the use of interrupted sutures only. The assistant must cut ligatures and sutures very close to the knot. In a number of cases cotton was used in infected wounds, but no sinuses developed.

Cooling in the Treatment of Traumatized and Potentially Infected Limbs.

ROBERT T. McELVENNY (*Surgery, Gynecology and Obstetrics*, August, 1941) summarizes F. M. Allen's findings and reports a case in which he himself has used ice to prevent the advance of bacterial infection. The patient was a man, aged fifty years, both of whose lower limbs had been amputated in a railway accident. The undercarriage of the cars had rained snow, mud and sand over the limbs; this material was ground up and mixed with clothing and with huge flaps of skin, muscle and bone. The patient when first examined was "bled out" and was suffering from profound shock; his blood pressure was 30 millimetres of mercury systolic and the diastolic pressure did not register. The administration of gum acacia solution was replaced as soon as possible by blood transfusion. The tourniquets were released, but left in position; the bleeding points were seized with hemostats, which were left in place. The stumps were wrapped in gauze soaked with a solution of sulphanilamide. Twenty hours after the injury a pronounced foul odour was emanating from the stumps. The patient was irrational and his blood pressure had not risen beyond 50 millimetres of mercury systolic and 10 diastolic. The diagnosis of pneumonia was confirmed and sulphapyridine was substituted for sulphanilamide. It was evident that nothing could at that time be done for the patient's lower extremities. The gauze was removed from the stumps and they were completely enclosed in shaved ice to two inches above the extent of tissue damage. No tourniquets were applied. Within one hour all pain ceased. Soon the foul odour vanished. The patient became rational and it was possible to take his temperature by mouth; the icing had caused it to fall to 97.2° F. Heat blankets were applied over his body and his oral temperature rose again to 101° F. Supportive treatment, including blood transfusion and three successive prophylactic doses of combined serum, was given. Fifty-eight hours after injury it was possible to operate on him; ethylene anaesthesia was used. Both lower extremities were elevated, high tourniquets were applied and a simultaneous bilateral amputation was performed. A "fish-mouth" type of incision was used; the muscle jumped

and retracted smartly. The flaps were allowed to fall together, soft rubber drains were inserted and a few loose silk worm sutures were used to approximate the flaps. No redness, induration or ecchymosis of either thigh was noticed at or below the site of amputation. During the operation the systolic blood pressure fell from 110 to 105 millimetres of mercury; a blood transfusion was given while the patient was on the operating table. The following day he broke into a profuse sweat and his temperature fell by crisis to normal. The chest condition rapidly resolved, and from that time recovery was uneventful. The author states that the appearance of the amputated parts was interesting. They were cold and firm, there was no gross evidence of infection or inflammation and the muscle was red and looked healthy. The fascia glistened and no blood clots were present. The blood was red and fresh looking; the mud and sand were moist and looked as on the day of the accident; the particles of sand were not sticking to the tissue. The subcutaneous fat was firm. There was no odour except from a few soft bluish-white tags of skin which had not been included in the ice. The author considers that although it is impossible to state which of the therapeutic measures was the determining factor in the result, the local icing did stop local pain, aid the patient in combating shock, and stop all odours emanating from the stumps. He thinks that further investigation should be carried out, and if the findings are confirmed the method should find wide application in severe wounds in both civil and military life.

Hydatid Cyst of the Lung.

JOSEF ARCE (*Archives of Surgery*, November, 1941) states that after the liver the lung is the most frequent site of the localization of hydatid cysts. The hexacanth embryos pass through the liver and are arrested in the lung filter. There they form cysts surrounded by a fine layer of connective tissue, and outside this by a layer of atelectatic lung. In the uncomplicated condition the cyst may give rise to no symptoms, or there may be slight hemoptysis, and occasionally pain if the cyst is in contact with the pleura. The cyst may empty into a bronchus and be completely expelled. At times the fluid only is coughed up, the hydatid membrane being left incarcerated owing to the smallness of the bronchus. The X-ray appearance of a round shadow as seen in the uncomplicated hydatid cyst is not diagnostic of hydatid disease; but certain events may happen which make the X-ray picture diagnostic. As the cyst approaches a bronchus, a small amount of air may be forced by breathing or coughing between the cyst and the adventitia. Where the cyst has ruptured, some air may also enter the cyst as well. In other cases the cyst wall may separate completely or disintegrate, and then the shadow of the cyst wall may be seen as it floats on the surface of the fluid, with air above the fluid level. All these appearances are diagnostic. The surgical approach to these cysts depends on the presence or absence of adhesions between the parietal and visceral pleura. The only certain method of diagnosis of these adhesions is by a preliminary induction of pneumothorax. Where adhesions are found to be present, approach is by rib resection and simple incision over the

cyst. But it may be found that the adhesions are not adequate, and to avoid danger from this cause it is recommended that a positive pressure anesthetic mask should be fitted, and pulmonary pressure can then be raised by the use of oxygen. The operation is usually performed under local anaesthesia. When adhesions are not present they may be produced by preliminary rib resection and packing of the wound with gauze; or pulmonary hyperpressure may be maintained during the operation in order to keep the two layers of pleura in contact. Another method is to suture the lung to the parietal pleura before opening the latter. But the author prefers in these cases to produce a preliminary pneumothorax in order to cause complete collapse of the lung, and to deal with it in this condition. Treatment of the cyst consists of aspiration of the fluid contents, incision of the overlying lung, and removal of the hydatid membrane. Marsupialization of the adventitia is performed by suture of the edges of the lung incision to the parietes, and in most cases drainage is provided to guard against the formation of a true lung abscess should small bronchi communicate with the adventitial pouch.

Foreign Bodies in the Lung.

CHEVALIER JACKSON AND CHEVALIER L. JACKSON (*The American Journal of Surgery*, October, 1941) discuss foreign bodies in the lung. These may reach the lung by inspiration through the natural passages or by penetration of the chest wall by missiles. In the case of penetrating foreign bodies it is often possible to remove them by bronchoscope, provided that they are small enough to pass through the bronchus which supplies the lobe involved. The procedure is simple if the foreign body lodges in the bronchus, but even if it is in the parenchymatous tissue bronchoscopic removal may still be performed with the aid of the biplane fluoroscope and penetrating forceps. All inspired foreign bodies should be removed except the minute particles concerned in pneumonokoniosis. A bolus of meat or a toy may become impacted in the laryngo-pharynx, obstructing normal inspiration, but permitting the escape of air during expiration. This valvular action leads to sudden atelectasis, which will rapidly prove fatal unless immediate tracheotomy is possible. When a small foreign body passes into the trachea there is usually gagging and choking as it enters the larynx, but this is followed by a symptomless interval in which the child appears quite normal. This interval may end in various ways. The body may be coughed out of a bronchus and come to lie across the bifurcation of the trachea or in the larynx and cause acute asphyxia. In the case of a dried bean or a peanut, the foreign body quickly swells and causes a fulminating reaction in the bronchial mucosa. If it is coughed free, it is very liable to be inspired into the other main bronchus. Immediate asphyxia is likely, as the previously affected lung is atelectatic and cannot at once resume function. The lungs appear to be remarkably tolerant of small metallic foreign bodies, such as small pins or tacks, as long as they are not causing bronchial obstruction. In these cases suppuration may be delayed for weeks or months. All inspired foreign bodies should therefore be removed by

bronchoscopic methods. If well planned and properly executed this operation should be successful in nearly 100% of cases.

Intussusception in Adults.

H. G. NICHOLS (*Surgery, Gynecology and Obstetrics*, December, 1941) gives a short review of previous reports on intussusception in adults, and adds another case to the list. This disease is generally speaking one of infants and young children. But it does occur in adult life. As is usually the case in children, the adult form may be idiopathic, but more often it is associated with some causal factor, such as tumour, diverticulum or ulcer of the intestinal canal. An intestinal anastomosis may be the site of origin, as may be the appendix. Trauma has been reported as a precipitating factor. Tumours being more common in the large bowel, it is this portion of the intestine which is most often affected. The signs and symptoms are those of strangulation and obstruction. But there may be no local tenderness or muscle rigidity, as the affected bowel is insulated from the parietal peritoneum by the ensheathing layer. Hydrostatic pressure reduction is not recommended. Though this method may be valuable in children, the intussusception in an adult is so often associated with some pathological causal factor that laparotomy is to be preferred. Reduction may be performed by gentle pressure over the apex of the tumour. Gentle compression of the whole of the mass may reduce oedema and aid reduction. It may be possible to insert the tip of the finger between the intussusceptum and the intussusciptens and so to dilate the neck. If the condition is irreducible by these methods, the neck may be incised in the same way that a dorsal slit is made for phimosis. After reduction the incision is closed carefully. Opening of the bowel and amputation of the intussusceptum as high as possible are not recommended. A large incision has to be made, and the manipulations inside the lumen of the bowel are liable to lead to peritonitis. Another satisfactory method is to fix the intussusceptum *in situ* with interrupted sutures and then to perform a lateral anastomosis to short-circuit the segment involved. Later the intussusceptum may slough off and be passed *per rectum*. In fact several cases have been reported in which, the diagnosis having been missed, no operation has been performed and the slough has been passed, with recovery of the patient. These spontaneous cases, however, are liable to be followed by intestinal obstruction due to cicatricial contracture. The method of anastomosis appears attractive, especially when the general condition of the patient contraindicates an immediate resection. When some pathological cause for the condition is found, such as tumour, it will be treated by resection in one or two stages, according to the general principles of bowel surgery.

The Role of X-Ray Examination in Intestinal Obstruction.

E. P. PENDERGRASS (*The New England Journal of Medicine*, October 23, 1941) discusses the best methods of using X-ray examinations to obtain accurate diagnosis of obstructive lesions of the small intestine and colon. Even in the acute cases fluoroscopic study with the patient in the horizontal and semi-

erect positions may give valuable aid, especially in the movement of the diaphragm; lateral views may reveal gas shadows in the rectum. The importance of gas shadows depends upon the fact that in normal conditions the gas and fluid are intimately mixed, whereas in obstruction and stasis the gas separates. Gas shadows may be produced by morphine and sedative drugs, peritoneal irritation, bacterial or chemical irritants, nutritional deficiencies, a ruptured Graafian follicle, anaemia. X-ray examination may be of value in elucidating the following points: whether the obstruction is single or multiple, whether it is complete or incomplete, its causation, its location, and whether it is an acute occlusion or a terminal stage of a chronic process. The value of posture in the taking of films is stressed, and the advantage of the combination of intubation with skiagraphy is also discussed.

Urethral Diverticulum.

G. C. SEYMOUR (*The Canadian Medical Association Journal*, November, 1941) describes a case of anterior urethral diverticulum complicated by calculi, and sets out a list of causes of such diverticula with their aetiology and classification. In the author's case the diverticulum was as large as a hen's egg. It occurred after a transurethral resection. The patient felt a mass three inches from the tip of the penis immediately after the operation, and the mass gradually increased in size until the patient sought treatment three years afterwards. Through a mid-line incision over the mass the diverticulum was dissected out, a catheter was passed and after the sac was opened the calculi and foul-smelling slimy fluid were evacuated, sufficient of the mucous membrane was left to allow a plastic closure of the urethra to be carried out. Diverticula of the urethra may be congenital or acquired. The constant sign is a tumour along the course of the urethra, pressure upon which causes a flow of urine from the external meatus. The tumour may enlarge and become tense on urination. When the condition is complicated by calculus, obstruction to the flow of urine may occur. Operative treatment varies with the cause. When the condition is due to calculus or stricture, removal of the cause is all that is necessary; but when it is due to perforation of the urethra or is congenital in origin, removal together with repair of the urethral canal is needed.

Intraspinal Dermoids.

C. F. LIST (*Surgery, Gynecology and Obstetrics*, October, 1941) reports five intraspinal dermoids and discusses the terminology and classification. He divides them into epidermoids (involving superficial layers of the skin) and dermoids (involving all layers of the skin and accessory organs, sebaceous glands, sweat glands and hair follicles). Dermal sinuses are tubular formations in direct connexion with the skin. The article is illustrated with reproductions of air myelograms and lipiodol myelograms, photomicrographs and drawings. The pathogenesis and the sex incidence and the distribution of each type within the spinal cord and its membranes are discussed. The clinical course of these lesions is long. The symptoms depend on the size and location of the lesion. Changes of the spinal fluid found in the various dermal formations are

similar to those observed in other intraspinal tumours, although the increase of total protein appears to be less than with neurinoma. In rare instances the lesion has been directly verified by aspiration of cholesteatomatous material at lumbar puncture. In cases of infected dermal sinus the spinal fluid may show various types of meningitic change. Treatment is surgical, and if it is complete, the results are good.

Methylene Blue as an Indicator for the Oral Administration of Food to the Surgical Patient.

B. I. GOLDEN and J. E. MARTIN, JUNIOR (*The American Journal of Surgery*, November, 1941) discuss the oral administration of food to the post-operative patient and also to the patient suffering from peritonitis. They consider that the withholding of food, once absorption can occur, is harmful to the patient and favours the onset of complications. The various clinical indications, such as continuance or cessation of post-operative vomiting, are not reliable guides to the correct juncture at which to institute feeding. The authors devised, therefore, what they claim to be a simple, harmless and reliable method of examining the power of the alimentary tract to absorb and of the kidneys to excrete. One grain of methylene blue in a capsule is given from six to eighteen hours after operation, the patient being asked to empty the bladder before taking the dye. As much water is given with the methylene blue as can be taken comfortably, and further amounts are given during the next three hours. At the end of this time the patient is again asked to empty the bladder. If greenish blue urine is obtained, the authors assume the ability of the intestine to absorb and of the kidneys to excrete. If on either occasion the patient is unable to void urine, the bladder is emptied by catheter. The authors state that since the application of this method they have observed a reduction in wound infections and in post-operative nausea and vomiting, and that they have almost eliminated the use of the Wangenstein appliance.

Desmoid Tumours.

ROBERT O. PEARMAN and CHARLES W. MAYO (*Annals of Surgery*, January, 1942) present a study of 77 cases of desmoid tumour and a review of the literature. They state that a desmoid tumour is a simple fibrous tumour that arises in musculo-aponeurotic structures and tends to infiltrate the muscle in which it lies. In several cases in the series under discussion the tumours had been considered by the clinician as intraabdominal; they had been mistaken for hydrops of the gall-bladder, a stone in the gall-bladder, a tumour of the omentum or mesentery, a pancreatic cyst, a uterine tumour, a tumour of bone or a tumour of the kidney. When the tumours were not situated in the abdominal wall they had generally been mistaken for sarcoma. The authors consider that the most logical theory of origin of the tumours is that they are brought about by trauma (accidental or operative trauma or the physiological trauma of labour) superimposed on an unknown individual predisposing factor. They have noted a peculiar change in the striate muscle fibres enclosed in the growth; this change appears to be a process of differentiation and results in the formation of multinucleated plasmodial masses resembling foreign body giant

cells. The tumours do not undergo metastasis, nor do they endanger life; nevertheless they tend to recur locally unless they are completely removed. Diagnosis is made by the discovery in muscle of a fibrous tumour which is fixed by contraction of the muscle, and by biopsy, which is indispensable. Treatment is by complete excision; irradiation appears to be of little value. In 55 of the 77 cases the tumour occurred in the striated muscle of the anterior abdominal wall, and in the other 22 cases it occurred in striated muscle elsewhere in the body. Only one patient in the series died; the cause of death was infection of the operative incision. Local recurrence was noted in seven of the 69 cases in which follow-up data were available. The authors have discovered no evidence that the tumour ever undergoes sarcomatous change.

Duodenal Atresia.

P. M. KELLY (*The British Journal of Surgery*, October, 1941) reviews the literature and reports a case of duodenal atresia in a female child, aged four days, in which gastro-enterostomy was successful. The author considers that the condition is not so rare as is generally believed. Buchanan describes duodenal atresia as being extrinsic or intrinsic. The extrinsic causes are: (i) peritoneal bands, (ii) adhesions, (iii) anomalous blood vessels, (iv) torsion, (v) volvulus. The intrinsic causes of the condition are: (i) a diaphragm across the lumen of a normal duodenum, (ii) blind ends which may or may not have a lumen, (iii) blind ends without a lumen. Various theories of causation have been put forward. Diagnosis rests on five points: (i) persistent vomiting from birth; (ii) the presence of bile and sometimes blood in the vomitus, the vomiting being projectile as a rule; (iii) fullness in the epigastrium, with or without peristaltic waves from left to right; (iv) constipation from birth, though meconium may be passed; (v) radiographic evidence after a barium meal. Early diagnosis is essential, to prevent dehydration of the infant before surgical measures can be undertaken. The differential diagnosis rests between duodenal atresia, atresia elsewhere in the gut, congenital hypertrophic pyloric stenosis and an oesophageal pouch. Other congenital defects may be present. The prognosis is poor, unless the atresia is partial and operation can be deferred beyond the first week or so. Gastro-enterostomy or duodeno-jejunosomy in the first few days of life provides the only hope of recovery in complete or subtotal atresia. The author discusses the surgical measures and the general care of the patient.

Anaphylactoid Purpura Simulating Acute Regional Ileitis.

C. G. BARNES AND G. W. DUNCAN (*The British Journal of Surgery*, October, 1941) report a case of anaphylactoid purpura in which visceral manifestations preceded those in the skin and joints. They state that such forms of purpura are usually divided into Schönlein's disease, in which the tissues around the joints are chiefly affected, and Henoch's purpura, in which the effusions occur principally into the walls of the bowel. The authors contend that there is no essential difference between the two, which may

occur together in the same patient. Their patient, a man, aged thirty years, was admitted to hospital on account of severe colicky pain in the right iliac fossa; he was treated according to the Ochsner-Sherren régime for subacute appendicitis for six days. On the fourth day two inflamed areas, poorly delineated, appeared on the dorsum of the hands; the blood was sterile. Two days later an attack of acute abdominal colic necessitated laparotomy. The appearances within the abdomen suggested acute regional ileitis; the colon, appendix and spleen seemed normal. On the next day the patient's condition had improved and dermatographia was pronounced all over the body; Hess's test produced a positive result. Twenty days later skin tests for hypersensitivity to common substances were without result, and the next day the patient complained of acute pain in both shoulders. He was treated with vitamin P, ephedrine and intramuscular injections of adrenaline in oil, and rapidly recovered. The authors suggest that the simple tests for dermatographia and capillary permeability should be carried out on any patient with obscure abdominal colic, and that if the results are positive the effect of an intramuscular injection of adrenaline should be tried before laparotomy is performed.

The Corpus Cavernosum as a Blood Transfusion Site.

RICHARD E. STRAIN (*The Lancet*, January 10, 1942) discusses blood transfusion sites and suggests that in certain circumstances the corpus cavernosum may be employed. It is a quickly available transfusion site of constant anatomical position; it withstands repeated punctures without hematoma formation and does not collapse during shock. It absorbs blood rapidly, is in a protected area where injury is infrequent, and does not bleed after the transfusion. The author has frequently used it when the superficial veins were collapsed and a rapid increase in blood volume was required. He does not recommend its use for infusion of anything but blood and blood plasma. Clotting blood is used. It is introduced by syringe, because gravity methods are too slow in the urgent cases in which this route is used. Usually no blood is obtained when the needle is introduced and aspiration is attempted; this is unimportant if the operator is familiar with the anatomy of the penis. The needle may be inserted into the corpus from the lateral aspect, or it may enter from the dorsum just to one side of the dorsal vein. It is essential to guard against injury to the dorsal vein between and above the corpora and to the urethra between and below them.

Sulphapyridine Calculus.

I. K. WONG AND DAO CHING (*The Chinese Medical Journal*, September, 1941) report a case of sulphapyridine calculus following the administration of 12 grammes of the drug. The patient, a male, aged nineteen years, was admitted to hospital suffering from right lobar pneumonia. He was given sulphapyridine orally, the initial dose being two grammes and subsequent doses one gramme four times a day. His chest condition rapidly improved; but about seventy-six hours after his admission to hospital he complained of severe pain in the right side of the abdomen and of pain of lesser degree

in the right lumbar region. He vomited several times and passed blood-stained urine. The pain persisted for several days with periods of aggravation. A cystoscopic examination revealed two small calculi at the right ureteral orifice; one was easily removed and the other crushed and later flushed out. The stone that was later examined was found to be composed purely of sulphapyridine crystals.

Intestinal and Mesenteric Injury by Non-Penetrating Force.

D. H. POER AND E. WOLIVER (*The Journal of the American Medical Association*, January 3, 1942) discuss intestinal and mesenteric injury following trauma in which the abdomen has not been penetrated. They analyse in detail 36 cases of their own and also refer to 1,476 cases collected from the literature. They think that there are three chief ways in which the abdomen may receive this type of injury. Intestinal rupture results most frequently from a crushing injury, in which the external force compresses the bowel against the spine or the pelvic bones. Occasionally tearing injury may result from a violent force applied at a tangent to the body. Bursting injuries of the normal bowel are rare, except those which result from the introduction of compressed air into the anal canal. Fourteen of their 36 cases followed blows on the abdomen by blunt objects, five followed falls, 11 followed automobile accidents, four were caused by kicks in the abdomen, and two were due to other injuries. The cases are described in three groups. In the first group diagnosis and treatment were delayed for more than twelve hours after the accident. There were 17 cases in this group. Two patients died without operation, 10 died following operation, and five recovered after operation. The second group comprised 14 cases. Nine patients recovered after operation and five died after operation was performed. In the third group, that comprising multiple severe injuries, there were five cases. All the patients died, three without operation and two after operation was performed. From a study of the 1,476 cases the authors conclude that distension of the intestine with fluid or food has contributed to the likelihood of rupture. They also refer to industrial accidents, in which the damage is caused by a blunt object striking the abdomen with considerable force. In accidents concerned with transportation, many forces are applied simultaneously; the patient moving in one direction comes forcibly against a fixed object or an object moving in the opposite direction, and a severe crushing injury is produced. The authors hold that even in the most favourable circumstances the mortality is in the neighbourhood of 35%, and they state that if this high mortality is to be lowered, earlier surgical intervention is required—the decision to operate must be based in many instances on intelligent suspicion alone. This suspicion should be built on a careful study of the accident, and particular attention should be paid to the exact details of how the abdomen was struck. If the type of accident arouses suspicion, the patient should be observed for four to six hours, and if after this time abdominal pain or tenderness on pressure can be evoked, the indications for operation are adequate. A constant rise in the pulse rate makes operation imperative.

British Medical Association News.

ANNUAL MEETING.

The annual meeting of the Tasmanian Branch of the British Medical Association was held at the Tasmanian Museum, Hobart, on February 21, 1942, Dr. C. CRAIG, the President, in the chair.

Annual Report of Council.

The annual report of the Council for the previous twelve months was read and adopted. The annual report is as follows.

The membership of the Branch, which was 95 at the beginning of 1941, was 97 at the beginning of 1942. Eight members have been transferred from other Branches, four have been elected, and six have resumed membership through payment of the overdue subscription; while three have left the State, one has died, and twelve have allowed their membership to lapse through non-payment of the subscription for 1941. Six of these have resumed membership since the beginning of the year.

Eleven general meetings of the Branch have been held, the average attendance being 15.4, compared with 11.5 last year.

Papers have been read by Mr. F. W. Fay, Mr. J. B. G. Muir, Dr. T. Butler and Dr. J. P. Millar; and a large number of cases have been demonstrated by Dr. T. Butler, Mr. Muir and members of the staff of the Royal Hobart Hospital.

Eight meetings of the Branch Council have been held, the attendances being as follows:

Mr. Craig	5	Dr. Gibson	7
Dr. Crowther	7	Dr. W. Freeman ¹ ..	0
Dr. Hillier	7	Dr. Millar ²	1
Dr. Grove	1	Dr. McDonald	2
Dr. Reid	2	Dr. J. Walch	8
Dr. Brothers	4		

The Branch has been represented on the Federal Council by Dr. Gibson and Mr. Craig. Dr. Gibson resigned from the position at the end of the year, and Dr. J. S. Reid has been appointed in his place.

The Branch has suffered a great loss in the death of two of its past presidents, Dr. A. W. Shugg and Dr. G. E. Clemons, both of whom were valued and persistent workers in the interests of the Association.

Among matters which have received consideration by the Branch Council during the year the following may be mentioned.

The scheme for compensation for loss of practice by members on active service was successfully brought into action early in the year, and Dr. Lines, Dr. W. Giblin, Dr. Newell and Dr. Thompson were appointed by the contributors to be trustees for the fund.

An appeal for financial aid for members of the profession in Great Britain was made by the Branch Council at the request of the Federal Council. The sum of £127 was subscribed by members and forwarded through the Federal Council.

The matter of payment for X-ray examinations under the *Workers' Compensation Act* received considerable attention. The matter was discussed with the Underwriters' Association and with the Chief Secretary. The Chief Secretary agreed to give consideration to an amendment of the regulations when opportunity offered.

Several draft schemes for a general medical service have received lengthy consideration, and the Federal Council has been advised of the views of the Branch Council concerning them.

A committee has been formed to advise the Chairman of the Liquid Fuel Control Board concerning petrol rations for doctors. This committee reviewed the rations allowed to all doctors in the State and made recommendations to the chairman. These recommendations are reconsidered from time to time as occasion arises.

With the object of saving petrol, efforts have been made to impress patients with the necessity of calling doctors before 10 a.m. Posters for exhibition in waiting rooms have been supplied and circulars for sending out with accounts; and letters have been sent to the secretaries of all lodges asking for their cooperation.

Problems arising from the shortage of doctors and nurses in the State have been considered by the Branch Council and by special meetings of the Divisions, and have been the subject of two conferences with the Premier.

¹ Resigned November 14, 1941.

² Appointed January 16, 1942.

Financial Statements.

The financial statement and balance sheet were presented and adopted; they are published herewith.

Election of Office Bearers.

The following office bearers were elected:

President-Elect: Dr. Alan Pryde.

Vice-President: Dr. Stuart Gibson.

Honorary Treasurer: Dr. J. P. Millar.

Honorary Secretary: Dr. J. H. B. Walch.

Member of Council: Dr. J. A. Newell.

Insufficient nominations having been received, the President declared two vacancies on the Branch Council.¹

Messrs. Adams and Bennetto were elected auditors.

Installation of President.

Dr. C. Craig installed Dr. W. E. L. H. Crowther in the office of President for the ensuing twelve months. Dr. Crowther thanked the members for having elected him to the President's chair, and on behalf of the Branch thanked Dr. Craig for his services to the Branch during his term of office. He also referred to the death of Dr. Albert William Shugg and of Dr. George Ernest Clemons, and said that the members of the Branch were sensible of the loss they had suffered.

President's Address.

Dr. C. Craig then delivered his President's address. He said that his address consisted of a number of reflections which had been forced upon him during years of practice.

He referred first of all to a salaried medical service, and said that as this subject had been very much under discussion lately, and as he had recently entered a salaried position again after some years of private practice, he thought it would interest practitioners to know how he enjoyed the change. There was no great point in discussing the matter fully, but he wished to say that in two matters he had experienced very great relief.

The first of these had to do with the business of assessing and collecting patients' fees. In a wealthy community this would not matter, but most Australian communities were not wealthy, and he had never been able to rid himself of the feeling that even very moderate fees were above the paying ability of the patients. Even if the moderate fee of fifteen guineas was charged for an operation, they had to remember that when the anaesthetist, the hospital and the chemist had been paid, the total amount paid out by the patient was something like thirty pounds. There were not very many households to whom this sum was not a big strain. Then again there were the numerous patients to whom one rendered services and who did not pay, and who had to be pursued by all sorts of methods in order to be made to pay. This was undoubtedly degrading to the doctor, although, curiously enough, many of these patients did not seem to resent this method of collection. It was a great relief to Dr. Craig to know that he was being paid a regular salary and was no longer saddled with this burden.

Dr. Craig went on to say that the next way in which he had experienced relief had to do with his relations with his colleagues. They were in Launceston as happy a medical community as was likely to be found anywhere, but nevertheless every doctor knew that in private practice he had to keep his patients to himself. He had therefore to stifle those powerful and generous instincts which impelled him to consult and discuss cases with his colleagues. He thought that if he asked for a consultation it would be thought to be a reflection on his own powers, and he had also to consider the point that his patients might take a liking to the doctor called in for consultation. In hospital practice none of these worries counted for anything, and one was able to take advantage of all the many opportunities for discussion and consultation.

There was one other aspect that was worth discussion. It happened that the medical services in Tasmania were run by a layman. It so happened that this particular layman was an experienced and tactful administrator. Were it not so the position would be intolerable. Should there ever be a general salaried service, medical practitioners would have to make quite certain that it was run by themselves.

Dr. Craig then spoke of what he called boredom in practice. He said that quite apart from the fact that most doctors had too much to do and too little time to do it in, there could be no doubt that a great deal of medicine was very boring. The reasons for this were undoubtedly that they did not yet know enough, and many problems were presented for which they had no key. For instance, in

¹ At a meeting of the Council later in the day Dr. B. Hillier and Dr. C. R. D. Brothers were elected to fill the vacancies.

the field of diagnosis. Present methods were not based, as they should be, on the analysis of individual symptoms. Doctors relied rather on the fact that over a very long period of time a great many very different syndromes had been separated out, some of which had been named as diseases and some of which had not. The method of diagnosis in any particular case was to build up by every possible method what was known as a clinical picture. With this picture in mind they then went from syndrome to syndrome and tried to fit in this particular clinical picture. It happened, however, that many of the clinical pictures which they built up were either incomplete or else did not fit into any of the classical syndromes. This was particularly so in ordinary general consulting room practice and in hospital medical out-patient practice. In these circumstances doctors found themselves completely at sea, and there was no shadow of doubt that in such circumstances they were very apt to make use of such terms as "neurotic", thus putting the blame onto the patient for their own diagnostic helplessness. There could be no shadow of doubt also that constantly having to grapple with problems to which there was no known key was unusually boring, as most minds liked to deal with something that was concrete and definite.

It so happened that within the last few years the key to many of these problems had been presented to medical practitioners. This was the key provided by what might be called the new psychology. Unfortunately very little advantage had been taken of this key, and most schools of medicine still concentrated on the somatic side of disease only. For this reason most doctors were quite unaware of what seemed to have been definitely proved, that symptoms could be produced by mental conflict and could be made to disappear by the solution of the conflict. Unfortunately this particular key could be gained only by long study and preparation. It seemed almost certain, however, that in the next fifty years it would be common to all doctors.

It so happened, however, that within the last few years another key had been provided, which was accessible to all practitioners. This key had been provided by the work of Lewis and Kellgren on the injection of "Novocain" into painful spots in muscles. It seemed to Dr. Craig impossible that anybody should continue in practice without being fully acquainted with this work. They should further study the series of cases reported by Kelly, who had had many successes with the method. Their experience in Launceston was as yet small, but they had also had unlooked-for success.

Another reason for boredom in practice had to do with therapeutics. They were taught, and very wisely taught, to be very sceptical in their belief in methods of treatment. They were taught to have belief only in a few drugs whose effect was beyond all possible doubt. This was undoubtedly very correct and very scientific, but there was no doubt also that it had taken most of the pleasure out of prescribing. The doctors of an earlier and less scientific generation were not so taught. They were taught that for almost every symptom there was a corresponding drug. They were taught that it was possible by minor alterations in prescriptions to produce corresponding results in the patient. All this had now gone by the board, and except in a few cases doctors prescribed without faith and without pleasure. In this regard Dr. Craig compared the pleasure of prescribing tincture of digitalis for fibrillation of the heart with the boredom of prescribing an alkaline gentian draft

with a small dose of "Sodium Luminal" for some complaint which was vaguely thought to have something to do with nerves.

The next cause for boredom was that the ordinary general physical examination in the great majority of cases produced no physical signs whatsoever. It had to be remembered that Dr. Craig was speaking of general and not of consulting practice. It was very tiring and wearying to have to do over and over again something which one knew was likely to produce no result at all, and it was owing to this fact and not to laziness that so many practitioners became offhand in their examinations. What was needed was an overhaul of "the overhaul".

Dr. Craig then discussed "the overhaul of 'the overhaul'". He said that "I want a good overhaul" was a phrase which at any particular moment was being used by patients in consulting rooms all over the world. Doctors were constantly being reminded that they were tending to rely less and less on the old-fashioned "overhaul" and more and more on the special methods of examination. This reminder was valuable inasmuch as it reminded them that a correct assessment of the patient's degree of illness could be made only by a personal inspection. It was also valuable in so far as it reminded them that diagnosis could be made only by the survey of the whole clinical picture and not a part of it. So far as it referred to the actual physical examination, however, it was particularly misleading. Apart from not making an examination at all, the young practitioner could hardly do worse than to rely on the consulting room overhaul in the diagnosis of early chronic disease. The usual examination that was set down in the examination forms of insurance companies could be taken as an example of a very thorough examination indeed. Yet it was amazing to think that these companies, who relied so much on the correct prognosis, should depend on such an incomplete mode of examination. The fact of the matter was that the ordinary consulting room examination would rarely pick up disease that was not already advanced. Looking through a number of cases in which he had made examinations for insurance companies in the last sixteen years, Dr. Craig found that he had not diagnosed the following conditions, which must have been present at the time of examination: tuberculosis of the lung, syphilis of the liver, chronic prostatitis, carcinoma of the bowel.

Had the method of examination that he would suggest been adopted, all these conditions might have been diagnosed. It was obviously impossible, when no leading symptoms were present, to apply to patients every special method of examination. It had struck him, however, that the following special methods should be among those applied in every case: X-ray examination of the chest, use of the Mantoux test, three examinations of the stools for occult blood, application of the Wassermann and Kline tests and microscopic examination of the urine. Even with these special methods of examination certain cases of early disease would be missed. The examining doctors, however, would not suffer so much from the feeling of having performed a worthless task. They would not be so bored.

In conclusion, Dr. Craig referred to biology and war. He said that most of those present had at some time during their lives believed in such ideals as disarmament plans, international peace, fair play to smaller nations, and so on. He had no doubt that most of them had by now dropped these ideas. They saw that, when acting in mass, man behaved not as a cultured and fair-minded individual would

THE BRITISH MEDICAL ASSOCIATION (TASMANIAN BRANCH).
Statement of Receipts and Payments for the Year ended December 31, 1941.

RECEIPTS.			PAYMENTS.		
	£	s. d.		£	s. d.
To Balance brought forward	587	11 9	By Commonwealth War Works Loan .. .	300	0 0
" Members' Subscriptions—			" British Medical Association, London ..	117	6 0
1941	365	7 6	" Federal Council, British Medical Association	29	8 0
1940	23	12 6	" Southern Division, British Medical Association	21	0 0
			" Northern Division, British Medical Association	26	10 0
	389	0 0	" Australasian Medical Publishing Company ..	115	0 0
" Interest on Fixed Deposit at Hobart Savings			" J. B. Welch—Honorarium	30	0 0
Bank	5	9 5	" Postage, Duplicating, Assistants' Salary et		
" Interest on Commonwealth Inscribed Stock	12	12 2	cetera	40	19 4
" Interest on Debentures, Australasian Medical			" Adams and Bennetto—Audit Fee .. .	2	2 0
Publishing Company	4	3 11	" Legal Expenses	6	6 0
			" Travelling Expenses, Members Branch Council	13	6 0
			" Printing and Stationery et cetera .. .	4	13 6
			" Bank Charges	0	12 7
			" Balance	291	13 10
	£998	17 3		£998	17 3

Statement of Assets.

	£	s.	d.
Cash at Banks	291	13	10
Deposit, Hobart Savings Bank	150	0	0
Commonwealth Inscribed Stock	300	0	0
Australasian Medical Publishing Company, Debt	95	0	0
War Savings Certificates	106	8	0
Commonwealth Loan	300	0	0
Furniture at Library	20	0	0
	£1,263	1	10

behave, but just as man in the mass had behaved before there was any higher culture at all, and before there was any thought of ideals. On this scale man was on a level with all other animals and was swayed by his desire to dominate or by his resentment at attempts at domination by others. It must be plain to all that this world was run by force and in the long run by physical force, and that the utmost they could hope for in the future was that force should be held in liberal hands.

Correspondence.

THE TREATMENT OF BURNS.

SIR: In view of the present state of emergency, your reprint of the British Ministry of Health's measures for the treatment of burns (*THE MEDICAL JOURNAL OF AUSTRALIA*, March 21, 1942, page 356) is certain to be read attentively.

An interesting point arises in connexion with the formula given for "triple dye" which calls for "neutral acriflavine". For the reasons which you printed a year ago (Albert, "Recent Advances in the Use of Acridine Antiseptics", *THE MEDICAL JOURNAL OF AUSTRALIA*, April 19, 1941, page 482), there has been a growing tendency overseas to replace the irritant and relatively toxic acriflavine by the bland and equally antiseptic proflavine, which was recently made official in the Fourth Addendum to the Pharmacopoeia.

In view of the fact that proflavine is being made in Australia by at least one manufacturer, it seems worth recording that a stable preparation is obtained when it is used instead of acriflavine (0.1%) in the "triple dye" formula. The successful treatment of burns with proflavine and tannic acid jelly is described by J. F. and R. M. Heggie (*The Lancet*, Volume II, 1940, pages 391 and 576).

Yours, etc.,

ADRIEN ALBERT.

Department of Organic Chemistry,
The University of Sydney,
April 2, 1942.

BLOOD SERUM IN THE TREATMENT OF BURNS AND WOUNDS.

SIR: "After the first dressing, the object which I always aimed at is to have the material in contact with the exposed tissues approximate as close as possible to the perfectly bland and neutral character of the healthy tissues." (Lord Lister.)

There seems to be a definite swing away from the treatment of burns by tannic acid. Devine, in the Royal Melbourne Hospital, has used a mixture of three dyes, and in *THE MEDICAL JOURNAL OF AUSTRALIA* of February 28, 1942, appears a letter by P. W. Gill stating that at Sydney Hospital *Unguentum Acidi Borici* (B.P.) is used. In the *British Medical Journal* have been papers on the use of "Milton", envelopes and closed plaster technique. None of these methods seems ideal or rational.

For several months I have been using blood serum as a dressing. After allowing the blood to stand for twenty-four hours the serum is pipetted off and kept in a refrigerator, and it does not matter if the serum freezes—in fact, it seems to keep better.

The burns are cleaned up in the usual way and the serum is gently sprinkled on. Gauze is applied and the serum application repeated every few hours over the gauze. Theoretically it would appear better if the serum were of the same blood group as the patient, but in practice it makes no difference. Although I have not used it, the

mixed serum put up by the Commonwealth Serum Laboratories for intravenous use should be admirable.

Nature causes serum to be exuded in any wound, and it is the evaporation of this which causes great fluid loss. The application of human serum should supplement the serum exudation of the patient and provide the tissues with an element in which they can repair themselves.

The ideal treatment of a case of severe burns would be blood serum internally and externally. I have had good results in every case and have used the serum externally, the main feature being the absence of pain. Reid and Bick, in *THE MEDICAL JOURNAL OF AUSTRALIA* of February 28, 1942, state that blood serum contains a vasoconstrictor substance formed in the process of blood clotting. This may account for the absence of bleeding I have noticed after repeated applications of blood serum to burns and wounds. The gauze does not seem to stick if it is kept moist with serum, and can be lifted off at will.

As blood can be obtained very easily and serum prepared by any medical practitioner, the method is costless and certainly approaches Lister's idea of the perfect dressing. Lister also stated: "Of all those who use antiseptics in surgery, I suspect I apply them least to the wound." So I do not think he would agree with the application of antiseptics to burns.

I am indebted to Dr. A. C. F. Halford, of Brisbane, for the quotations of Lister (see *British Medical Journal*, November 22, 1941).

Yours, etc.,

F. W. SIMPSON.

179, Saint George's Terrace,
Perth,
March 16, 1942.

A FRACTURE SERVICE: ADDENDUM.

SIR: In my letter of March 28 I omitted to acknowledge that the fracture clinic of St. George District Hospital was developed by Dr. Webb and Dr. McDonald, now on active service, and that my own position there is but a temporary war-time appointment.

It has also been pointed out that the figures for the size of the clinic might possibly be capable of misinterpretation. They should read to the effect that at the time of writing in-patients had numbered about 30, and about 55 out-patients (not new patients only) attended weekly.

Yours, etc.,

C. C. McKELLAR.

143, Macquarie Street,
Sydney,
April 5, 1942.

National Emergency Measures.

THE NECESSITY FOR ECONOMY IN X-RAY FILM AND RADIOGRAPHIC MATERIALS.

THE following note is published at the request of the Australian and New Zealand Association of Radiologists and with the approval of the Medical Equipment Control Committee.

The cellulose acetate (celluloid) of which an X-ray film is made is obtainable only in the United States of America, so that the difficulties of shipping space and the risk of transport, whether this base is treated in America, England or Australia, are very apparent.

Of the chemicals necessary to manufacture the emulsion for the coating of this X-ray film, the components of the silver salt alone are found in Australia. It is therefore important that during this national emergency the use of film be restricted as far as is consistent with medical diagnosis.

The following suggestions are made:

- Less film be used (chest, lumbar, spine, pyelograms *et cetera*).
- Smaller films be used (women and children do not need the same size film as a man).
- Pictures of different positions of extremities to be taken on one film.
- Hospitals for chronic diseases (tuberculosis and otherwise) to be asked to extend the time between X-ray examinations of their patients as long as possible.

- (e) Resident medical officers and the honorary staff of public hospitals be asked to determine as far as their clinical acumen will allow, the site of the lesion and by so doing lessen the number of films unnecessarily exposed.
- (f) Radiologists in their private practice and in their honorary capacity at public hospitals be requested to supervise strictly the number of films taken in each case.
- (g) X-ray technicians be instructed that not only in the radiographic department, but also in the processing (dark) room, care must be exercised to see that no film is wasted.
- (h) In order to impress on the radiographic staff the constant economy in the use of X-ray film, a chart or graph be prominently displayed each month showing the amount of film used compared with the number of patients examined.

Again, with no likelihood of early relief in overseas deliveries, available metol and hydroquinone supplies must be used with great care. These important ingredients in X-ray film developers became extremely scarce in the last war and are again likely to be very difficult to obtain. Therefore it again seems of national importance to see that there is no waste of these materials.

- (a) Developing solution not in actual use should be covered by a floating lid to prevent oxidation.
- (b) An "acid stop bath" may be used after development and before the film is placed in the fixing solution. It neutralizes the alkali of the developer, thus giving a longer working life to acid fixing solution.
- (c) Economy may be obtained by keeping the contents of the developing tank at the same level by the addition when necessary of a "replenishing solution". (This consists of the ordinary developing solution without the quantity of sodium bromide and so does not retard the development of the films.)

In conclusion this association is in close touch with manufacturers and suppliers of X-ray film in Australia and New Zealand, and full information and cooperation are assured regarding any future developments.

Naval, Military and Air Force.

APPOINTMENTS.

THE undermentioned appointments, changes *et cetera* have been promulgated in the *Commonwealth of Australia Gazette*, Numbers 100 and 107, of April 1 and 9, 1942.

PERMANENT NAVAL FORCES OF THE COMMONWEALTH (SEA-GOING FORCES).

Ante-dating Seniority.—The seniority of Surgeon Lieutenant Charles Patrick Cummerford Rilly is ante-dated to 30th April, 1939.

AUSTRALIAN IMPERIAL FORCE.

Australian Army Medical Corps.

The following changes *et cetera* are made: Lieutenant-Colonel F. B. Craig is appointed to command a Hospital Ship, *vice* Lieutenant-Colonel H. L. Kenihan, 17th February, 1942.

Major E. E. Dunlop to be Lieutenant-Colonel (Temporarily) whilst commanding an Allied General Hospital, 26th February, 1942.

ROYAL AUSTRALIAN AIR FORCE.

Citizen Air Force: Medical Branch.

William Allan McKay, M.B., B.S. (3472), is appointed to a commission on probation with the rank of Flight Lieutenant with effect from 1st December, 1941.

Previous notification appearing in *Commonwealth of Australia Gazette*, No. 15, dated 15th January, 1942, referring to William Allan McKay, M.B., B.S., is cancelled.

Norman Duffin Barr, M.B., B.S. (3440), is appointed to a commission on probation with the rank of Flight Lieutenant with effect from 3rd November, 1941.

Notification appearing in *Commonwealth of Australia Gazette*, No. 15, dated 15th January, 1942, referring to Norman Duffin Barr, M.B., B.S., is cancelled.

Douglas Gordon Carruthers, M.B., Ch.M., F.R.A.C.S. (3952), is appointed to a commission on probation with the rank of Flight Lieutenant and is promoted to temporary Squadron Leader with effect from 9th February, 1942.

The appointment of Flight Lieutenant E. J. Ware (2755) is terminated with effect from 16th February, 1942.

Flight Lieutenant A. G. R. Uglow (1196) is transferred from the Reserve to the Active List with effect from 16th February, 1942.

The following are appointed to commissions on probation with the rank of Flight Lieutenant with effect from 16th February, 1942: Alexander George Brodsky, M.B. (3896), Isadore Irvine Brodsky, M.B. (3895), John Joseph Connolly, M.B., B.S. (3899), Alan Alfred Crook, L.R.C.S., L.R.C.P. (3894), Walter Raymond Fancourt Fox, M.B., B.S. (3909), Claude Lamb Gibbons, M.B., B.S. (3898), William Geoffrey Jasper, M.B., B.S. (3897), Harold Raymond Worth, M.B., Ch.B. (3893).

Reserve: Medical Branch.

Group Captain R. Fowler relinquishes his commission with effect from 5th January, 1942.

Hugh Graham Andrew, M.B., B.S. (3733), is appointed to a commission on probation with the rank of Flight Lieutenant with effect from 17th December, 1941.

Notification appearing in *Commonwealth of Australia Gazette*, No. 15, dated 15th February, 1942, referring to Hugh Graham Andrews, M.B., B.S., is cancelled.

The following are appointed to commissions on probation with the rank of Flight Lieutenant with effect from the dates indicated: Alexander William Graham, M.B., B.S. (3954), Malcolm Charles McKinnon, M.B., B.S. (3953), 11th February, 1942.—Ex. Min. No. 53—Approved 6th April, 1942.

Obituary.

WALTER FERGUSON STRAEDE.

THE following tribute to the memory of the late Dr. Walter Ferguson Straede has been received from the resident medical officers of the Royal Melbourne Hospital.

The tragic and untimely death of Dr. Walter F. Straede has aroused the desire on the part of the resident medical officers of the Royal Melbourne Hospital to pay tribute to this brilliant young man. He was a resident medical officer of the hospital from January to June, 1941, having completed a brilliant medical course. His outstanding intelligence was devoted to the link between pure physiology and clinical material, and to this end he worked enthusiastically during his stay at the hospital.

His service at the hospital was abbreviated by his appointment as "flying doctor", but before he left he had gained the affection of all those with whom he worked.

We offer our sincerest sympathy to his family.

FRIEDRICH CARL BECHTEL.

DR. FRIEDRICH CARL BECHTEL, whose death was announced in these pages some weeks ago, was born at Normanton, Queensland, in November, 1889. He first of all attended the local school at Normanton and was then sent to the Church of England Grammar School, North Sydney. He excelled at sport, particularly at football, and won several trophies for running events. From North Sydney he went to the University of Sydney to study medicine, and graduated as Bachelor of Medicine in 1915, taking out his Ch.M. degree the following year. After serving as resident medical officer at the Royal Prince Alfred Hospital he filled a similar position for a while at the Brisbane General Hospital.

Bechtel enlisted for service in the war of 1914-1918. After the signing of the armistice he settled at Coorparoo, Queensland, being one of the first doctors to practise in the district. He served for a while on the honorary staff of the Brisbane Hospital and also on the medical side at the Mater Misericordiae Hospital, Brisbane, holding the latter position from 1919 until quite recently. He was appointed medical officer to the baby clinic at Five Ways, Brisbane, and served in this capacity until he enlisted for service in the present war; he was for some years visiting medical officer at the creche and kindergarten, Five Ways. In 1940 he offered for military service, and in July, 1941, was appointed to the staff of a general hospital in Queensland. He served at camps and general hospital until five days before his death.

Bechtel, who had played a good game of tennis in his younger days, became fond of bowls and was president of the East Brisbane Bowling Club for a period and also of the Coorparoo Club. He was a successful gardener. He endeared himself to a wide circle of friends and acquaintances.

Australian Medical Board Proceedings.

TASMANIA.

THE undermentioned have been registered, pursuant to the provisions of the *Medical Act, 1918*, of Tasmania, as duly qualified medical practitioners:

- Roberts, Herbert Spencer, M.B., Ch.M., 1925 (Univ. Sydney), D.T.M., 1938 (Univ. Sydney), Snug, Tasmania.
Hull, Eric Douglas, M.B., Ch.M., 1926 (Univ. Sydney), Port Cygnet.

NEW SOUTH WALES.

THE undermentioned have been registered, pursuant to the provisions of the *Medical Practitioners Act, 1938-1939*, of New South Wales, as duly qualified medical practitioners:

- Macleod, Pam, M.B., B.S., 1940 (Univ. Queensland), Manly District Hospital, Manly.
Bearblock, Arthur, M.R.C.S. (England), L.R.C.P. (London), 1920, c.o. E. S. and A. Bank, Sydney.
Cust, Austin Donaldson, M.B., B.S., 1920 (Univ. Melbourne), Commonwealth Medical Officer, G.P.O., Sydney.
White, Richard Cecil, M.B., B.S., 1941 (Univ. Sydney), Eastern Suburbs Hospital, Waverley.
Sanders, John Vyvyan, M.B., B.S., 1941 (Univ. Sydney), Newcastle Hospital, Newcastle.
Rosati, Filippo, M.B., B.S., 1941 (Univ. Sydney), General Hospital, Newcastle.

The following additional qualifications have been registered:

- Dunn, Ross McPherson (M.B., B.S., 1935, Univ. Sydney), M.S., 1941 (Univ. Sydney), Allawah.
Purser, Cecil (M.B., Ch.M., 1890, Univ. Sydney), F.R.A.C.P., 1938, Wahroonga.
Walkingshaw, Richard (M.B., Ch.B., 1923, Univ. Glasgow, F.R.C.S., Edinburgh, 1937), D.O.M.S. (London), 1932, Sydney.

The following changes of name have been registered:

- Minahan, Mary Agnes, M.B., Ch.M., 1923 (Univ. Sydney), Waverley, name now Gladwell, Mary Agnes.
MacDonald, Agnes Helen, M.B., B.S., 1939 (Univ. Sydney), Leura, name now Fitzgerald, Agnes Helen.

Nominations and Elections.

THE undermentioned have applied for election as members of the New South Wales Branch of the British Medical Association:

- Dolman, Bruce Hunter, M.B., B.S., 1941 (Univ. Sydney), 46, Mona Road, Darling Point.
Rosenman, David Hersch (registered in New South Wales, December, 1941, in accordance with the provisions of section 17A of the *Medical Practitioners Act, 1938-1939*), c.o. Dr. Blaxland, Chertsey Street, Merrylands.

The undermentioned has applied for election as a member of the South Australian Branch of the British Medical Association:

- Cherry, Alan Percival, M.B., B.S., 1941 (Univ. Adelaide), Alberton, South Australia.

Medical Appointments.

Dr. Edward Clifford Varley and Dr. David McGowan Steele have been appointed Public Vaccinators at Camperdown and Lismore, Victoria, respectively.

Under the provisions of the *Quarantine Act, 1908-1924*, Dr. Donald McFie has been appointed Deputy Quarantine Officer at Townsville, Queensland, and Dr. Ronald Aymer Green has been appointed Deputy Quarantine Officer at Port Kembla, New South Wales.

Books Received.

"A Synopsis of Hygiene", by G. S. Parkinson, D.S.O., M.R.C.S., L.R.C.P., D.F.H., Lieutenant-Colonel R.A.M.C., with a section on personal hygiene by G. P. Crowden, D.Sc., M.R.C.S., M.R.C.P.; Seventh Edition; 1942. London: J. and A. Churchill Limited. Medium 8vo, pp. 720, with 16 illustrations. Price: 25s. net.

"Tropical Medicine", by Sir L. Rogers, K.C.S.I., C.I.E., LL.D., M.D., B.S., F.R.C.P., F.R.C.S., F.R.S., and Sir J. W. D. Megaw, K.C.I.E., B.A., M.B., Honorary D.Sc. (Queen's University, Belfast); Fourth Edition; 1942. London: J. and A. Churchill Limited. Royal 8vo, pp. 548, with 2 coloured plates and 87 text figures. Price: 21s. net.

Diary for the Month.

- APR. 24.—Queensland Branch, B.M.A.: Council.
APR. 24.—Tasmanian Branch, B.M.A.: Council.
APR. 30.—New South Wales Branch, B.M.A.: Branch.
APR. 30.—South Australian Branch, B.M.A.: Branch.
MAY 1.—Queensland Branch, B.M.A.: Branch.
MAY 6.—Western Australian Branch, B.M.A.: Council.
MAY 7.—South Australian Branch, B.M.A.: Council.
MAY 8.—Queensland Branch, B.M.A.: Council.
MAY 12.—Tasmanian Branch, B.M.A.: Branch.

Medical Appointments: Important Notice.

MEDICAL PRACTITIONERS are requested not to apply for any appointment mentioned below without having first communicated with the Honorary Secretary of the Branch concerned, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

New South Wales Branch (Honorary Secretary, 135, Macquarie Street, Sydney): Australian Natives' Association; Ashfield and District United Friendly Societies' Dispensary; Balmain United Friendly Societies' Dispensary; Leichhardt and Petersham United Friendly Societies' Dispensary; Manchester Unity Medical and Dispensing Institute, Oxford Street, Sydney; North Sydney Friendly Societies' Dispensary Limited; People's Prudential Assurance Company Limited; Phoenix Mutual Provident Society.

Victorian Branch (Honorary Secretary, Medical Society Hall, East Melbourne): Associated Medical Services Limited; all Institutes or Medical Dispensaries; Australian Prudential Association, Proprietary, Limited; Federated Mutual Medical Benefit Society; Mutual National Provident Club; National Provident Association; Hospital or other appointments outside Victoria.

Queensland Branch (Honorary Secretary, B.M.A. House, 225, Wickham Terrace, Brisbane, B.17): Brisbane Associated Friendly Societies' Medical Institute; Bundaberg Medical Institute. Members accepting LODGE appointments and those desiring to accept appointments to any COUNTRY HOSPITAL or position outside Australia are advised, in their own interests, to submit a copy of their Agreement to the Council before signing.

South Australian Branch (Honorary Secretary, 178, North Terrace, Adelaide): All Lodge appointments in South Australia; all Contract Practice appointments in South Australia.

Western Australian Branch (Honorary Secretary, 205, Saint George's Terrace, Perth): Wiluna Hospital; all Contract Practice appointments in Western Australia.

Editorial Notices.

MANUSCRIPTS forwarded to the office of this journal cannot under any circumstances be returned. Original articles forwarded for publication are understood to be offered to THE MEDICAL JOURNAL OF AUSTRALIA alone, unless the contrary be stated.

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